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DEPARTMENTS

METAL FINISHING articles are listed regularly in the Engineering Index and the Industrial Arts Index.

BARD-PARKER

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Finished to meet the exacting standards set by the world's leading surgical knife

Again THE LEA METHOD Lends A Helping Hand

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If you have a finishing problem—whether it involves cost, quality, or method—why not let our research department help? Our many years of experience should be quite useful.

THE LEA MANUFACTURING CO.

Waterbury, Conn.

Specialists in the Production of Clean-Working Buffing and Polishing Compounds

VOL. 38, NO. 7 METAL FINISHING JULY, 1940
PREPARATION, ELECTROPLATING, COATING

On the Dayton Convention of the A.E.S.

The 28th Annual Convention of the A.E.S. concluded on June 14, was the most successful ever held from the point of attendance, with 610 registrants. In addition, the papers were excellent with several particularly outstanding. The pre-printing of papers enabled intelligent discussions with no reduction in attendance at the technical sessions. Every detail was taken care of by the Dayton committee which deserves warm congratulations for its efforts.

However, there were two factors which detracted from the general success of the convention and they were out of the control of the committee. These factors were hot weather and inadequate hotel facilities.

Who can forget the stifling heat of some of the conventions held at Chicago, Washington, Philadelphia, Indianapolis, Toledo; the night educational sessions held at Bridgeport and lately, the humid weather at Dayton. It is true that some of the conventions mentioned were held later in the summer than Dayton's.

The change in the constitution was made to avoid hot weather, but experience has indicated that the change was not entirely successful. Why should the attendants have to endure hot, humid weather which mars the International Fellowship Club Party, reduces attendance at Educational Sessions, and makes dancing an ordeal of a Turkish bath? The program is sufficiently strenuous without having one's strength exhausted by the heat.

To overcome this handicap to conventions, we suggest that the A.E.S. Constitution be changed to allow the conventions to be held in early May or late September. The fiscal year would have to be changed also to coincide with the convention dates.

The other factor often detracting from conventions is inadequate hotel facilities. At Dayton, the attendants at the convention were spread out among at least five hotels. As a result there was a noticeable drop in visiting among members and the chances of meeting other conventionites were greatly reduced. One of the important features of the conventions is the possibility of meeting other members to discuss plating problems and to exchange greetings. These are greatly facilitated by having all the members under one or two roofs. This problem could be obviated by only awarding the conventions to cities that have hotels of such capacity that all of the attendants could be housed in a maximum of two hotels.

Twenty-Eighth Annual Convention of the A.E.S. Held at Dayton

The annual convention of the Society, held at Dayton, Ohio, June 11-13 had the largest attendance of any annual convention with 608 members and guests present.

Early Sunday night, the Biltmore Hotel, convention headquarters, was overcrowded and new arrivals were sent to four other hotels, taxing the limit of their capacity. Every detail was thoroughly taken care of by the Committee. The only factor marring the meeting was the intense heat throughout the four days.

At the first business meeting held on Monday morning, general chairman, *Chas. C. Conley* welcomed the delegates, members and visitors, after which *E. W. Cochran*, president of the Dayton Branch addressed the members. The feature of the meeting was the presidential address by retiring president, *Ray M. Goodsell*. Dayton's honorary member, *Walter Fraine*, also addressed the meeting.

At the business session held on Friday afternoon, *Frederick Fulforth*, vice-president of the Society was elected president. *Joseph Underwood* of Philadelphia nominated Mr. Fulforth and *LeRoy Critchfield* of the Lancaster Branch, seconded the nomination.

Ellsworth Candee, popular member of the Waterbury Branch, was elected first vice-president. *Joseph Downes* of the New Haven Branch nominated Candee and the seconding was done by *Austin Wilson* of the Detroit Branch. *James Hanlon* of the Chicago Branch was also nominated and with a roll call vote, Mr. Candee was elected.

Frederick Fulforth
Elected Supreme President

Nelson Sievering of the Newark Branch was promoted from 3rd vice-president to 2nd vice-president. *Horace Smith* of Newark and *John Feeley* of Montreal made the nominations.

Chas. C. Conley of Dayton and general chairman of the convention, was elected 3rd vice-president; *Walter Fraine* of Dayton and *Thomas Slattery* of Washington being his nominators.

Austin Wilson, chairman of the Research Committee announced that the committee, after considerable deliberation had appointed *Gerald A. Lux* of the Rochester Branch to be the new Research Associate.

A report on the finances of the Research Committee was also made during the business session.

A motion to appoint a Papers Committee to assist in the editing of papers, made by the Philadelphia Branch, was rejected.

Ellsworth Candee
Elected Supreme 1st vice-president

Nelson Sievering
Elected Supreme 2nd vice-president

Chas. C. Conley
Elected Supreme 3rd vice-president

C. L. Faust
Winner of Proctor Memorial Award. Co-Authored with C. A. Zapffe.

E. A. Anderson
Winner of $50.00 A.E.S. Award for paper co-authored with C. E. Reinhard.

Frank C. Mesle
Winner of Founders' Gold Medal.

A proposed amendment from the Los Angeles Branch clarifying honorary membership was also rejected. Grand Rapids Branch's amendment limiting the number of honorary members was modified to limiting the number to 18, the amendment being passed.

Prize Awards

The Committee on Prizes and Awards of which *Dr. C. B. F. Young* was chairman, announced the following winners:

Proctor Memorial Award—*Carl A. Zapffe* and *C. L. Faust*, Research Engineers, Battelle Memorial Institute, Columbus, Ohio, for the paper "Metallurgical Aspects of Hydrogen in Electroplating". (1940 convention).

Founders Gold Medal—*Frank C. Mesle*, "Adhesion of Electrodeposits" (1939 convention).

A.E.S. Gold Medal—*Dr. A. Kenneth Graham*, "A Study of Electrolyte Films" (1939 convention).

The $50.00 award for the best paper published in the Review during the year was given to *E. A. Anderson* and *C E. Reinhard*, N. J. Zinc Co., for the paper "Alkaline Cleaning and Copper Blistering," March 1940 Review.

Samuel Huenerfauth cup for the Branch presenting the best paper at the convention, presented to *New York Branch*, for the paper entitled "Bright Nickel Processes" (1940 convention). This was an error as the cup should have been given for the best Branch paper read at the 1939 convention.

Exhibits: Metal Industry cup was won by the *Cincinnati Branch*.

1st. Certificate Award, *T. R. Schwalm*, Lancaster Branch.

2nd. Certificate Award, *John Hines* and *Matthew Dudek*, Philadelphia Branch.

3rd. Certificate Award, *Harmon S. Hunt* and *J. Marshall*, Newark Branch.

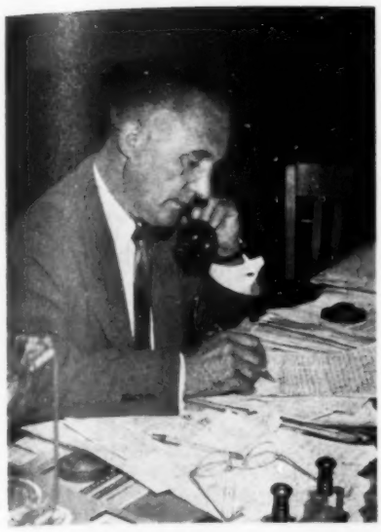
International Fellowship Club

The features of the International Fellowship Club were up to its usual standards.

At the annual luncheon Monday noon, with 65 members in attendance, *Dave X. Clarin*, Northeastern Div. manager of Oakite Products, Inc., New York, was unanimously elected chairman. *Richard "Dick"*

Photograph of men who attended Dayton conventions of 1915 and 1940.

Joe Barron and Andy Garrett in a happy moment at the Stevens plant inspection. Jack Mayers, Bob Green, Bill Geissman and Phil Ritzenthaler on right.



Dave X. Clarin

Dave is a triple-threat man, being Northeastern Div. manager of Oakite Products, Inc., founder of the Aunt Ella Society and new chairman of the International Fellowship Club.

Crane of Lea Mfg. Co., Waterbury, Conn., was elected vice-chairman to succeed *Fred Norgren* of Frederic B. Stevens, Inc. The annual ladies' party held under the sponsorship of the International Fellowship Club under the auspices of *Joan Trumbour* of METAL FINISHING, was held on Wednesday afternoon at the Springfield Country Club after the luncheon given through the courtesy of *Frederic B. Stevens, Inc.* Games were enjoyed and numerous prizes donated by various supply houses were given.

Golf Tournament

On Wednesday afternoon at the Springfield Country Club, the annual golf tournament was held. *Prof. Edwin M. Baker* of the University of Michigan, Ann Arbor, Mich., was winner of the golf trophy.

Outing

A feature of the meeting was an outing held Wednesday afternoon through the courtesy of *Frederic B. Stevens, Inc.*, Detroit. Buses took the members from their hotels to the *Mitchell Engineering Co.*, Branch of Frederic B. Stevens, Inc., for inspection of the latest type of automatic plating equipment in operation. Refreshments were also served. The members were then transported by bus to the Springfield Country Club where they enjoyed a luncheon, again through the courtesy of Frederic B. Stevens, Inc.

The afternoon was spent in recreations with an East versus West ball game, golf tournament and last, but not least, swimming.

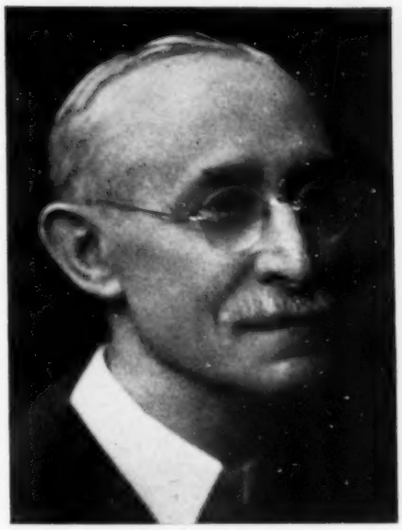
Plated Ware Exhibit

The exhibit of plated ware was one of the finest ever held, and in addition was conveniently located adjacent to the registration desk and the room where the educational sessions were held. *G. Lewis Smith* was chairman of the Exhibit Committee.

Meeting of Past Presidents

The past presidents of the A.E.S. held their annual dinner on June 12 at the Biltmore Hotel with 14 in attendance.

The usual open forum discussing amendments to the constitution and other matters took place. A card was sent to a sick member, *Walter S. Barrows* of Toronto, Can.



Walter Fraine

Past Supreme President and Honorary Member who took an active part in both Dayton conventions.

The following past presidents of the Society were present:

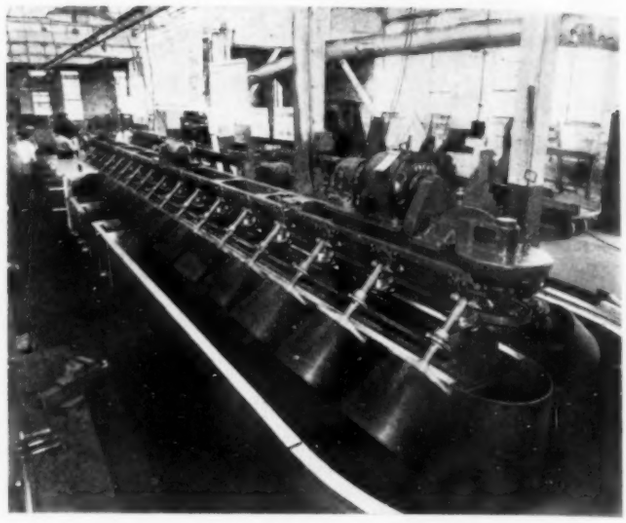
Walter Fraine, Chairman
Frank J. Hanlon, Secretary
George B. Hogaboom
Oscar E. Servis
Sylvester Gartland
John Feeley
E. J. Musick
Frank C. Mesle
Austin Wilson
Horace Smith
Thomas Slattery
E. Steen Thompson
H. A. Gilbertson
Ray M. Goodsell

Milwaukee Delegation at Stevens party. Andy Garrett drinking pop, (Boston). Phil Ritzenthaler, Bill Geissman, Ray Goodsell and Robert Goodsell, all drinking tonic.

Walter Fraine giving some fatherly advice to Ed Musick of St. Louis.

At Frederic B. Stevens Co.'s Exhibit

The Conventioneers were greeted by welcome banner and refreshments.



Full view of automatic for bulk plating.

The hosts—Joseph Cluff (right), Stevens' Pres., and Jack M. Mayers (left) Vice-Pres.

Three prominent A.E.S. men—left to right—Thomas Slattery, Dr. Wm. Blum and Frank Hanlon.

Stevens' engineer, Al Hannon (right), explaining how it works.

Left to right—Ed Charleson of Yale & Towne, the editor, and G. E.'s Joe Sterling watching an automatic bulk plating unit.

Guests were everywhere giving the equipment a thorough examination.

Papers

For the first time, papers were preprinted and a few members feared that preprinting might detract from the attendance at the meetings. However, these fears were not realized as the meetings were well attended in spite of the hot, humid weather.

The preprinting also enabled more intelligent discussion of the papers. The new lapel microphone purchased by the Supreme Society proved its worth and enabled easy presentation of the papers. Resumes of the technical papers presented, follow.

Resumes of Technical Papers

The Magnesium Copper Sulphide Rectoplater as a Source of DC Power for Electroplating

By C. A. Kotterman and W. R. Binai
P. R. Mallory & Co., Indianapolis, Ind.

The mechanism of the magnesium copper sulphide rectifier is described. Fundamental transformer-rectifier circuits are evaluated in terms of useful power supplies for electroplating. Air blast cooling of transformers and rectifiers is discussed showing how economical and compact power supplies result. Two different types of plating power supplies are described; one being the custom built Rectoplaters in capacities of 1000 amperes and upward; the other a simplified standardized power pack having two or three voltage outputs with a capacity of 500 or 750 amperes per bridge. DC voltage control of the Rectoplater is by means of a primary tap selector switch providing a voltage adjustment of one-half voltage to full voltage in 8 to 12 steps. DC output voltage of the Plater Power Packs is by means of an auxiliary auto-transformer, available as an accessory, where one-half to full voltage output adjustment is required and provides a remote control for the power supply. The article is concluded with a summary of the advantages of the magnesium copper sulphide rectifier as a DC power supply for electroplating.

METAL PREPARATION AND CLEANING

The Plating and Heating of Zinc Base Die Castings

By Floyd F. Oplinger
Assistant Manager, Electroplating Div., E. I. duPont de Nemours & Co., Inc., Wilmington, Dela.

The results of extensive plant tests on the plating of zinc base die castings are reported. Blistering of plated die castings has been found to be due in many cases to over-cleaning or over-pickling, resulting in excessive attack on the surface of the casting, leading to increased rate of diffusion between the copper and the zinc base surface. Recommended procedure for plating includes: (1) solvent cleaning, preferably in a 3-phase degreaser; (2) alkaline cleaning in a very mild alkaline solution for short periods of time (30 sec. to 2 minutes). Concentrations as low as 0.4 ozs./gal. of trisodium-phosphate have been used as an immersion cleaner. Dilute cleaners that are frequently discarded are recommended. Much diluter acid dips than are customarily used are suggested and for best results, a hydrochloric acid dip with concentrations from 0.5 to 1% by volume are preferred.

Using the recommended dilute alkaline cleaner and dilute acid dip, cathodic cleaning at 6 volts was found to work satisfactorily.

The Relationship of Cleaning Techniques and Adhesion of Electrodeposits

By B. F. Lewis
Technical Director, Northwest Chemical Co., Detroit.

The author discusses the tendency for certain alkaline cleaners to cause films on the surface of steel being cleaned, which may result in non-adhesion of the electroplate, and consequently the use of unduly active pickles is required to overcome these film-forming effects. For anodic cleaning of steel, the following recommendations are given:

1. Maintain a high ratio of alkali to radicals, such as phosphate, silicate or resinate.
2. Operate the bath at temperatures high enough to promote mobility of the solution and rapid replacement of alkali at the anodic work surface.
3. Avoid excessive current density, especially when conditions (1) and (2) are not under control.

Photomicrographs were given to illustrate the effects of over-cleaning of zinc base die castings, particularly increased diffusion of copper deposits into the zinc. Elimination of hydrogen absorption in the die castings by use of anodic cleaning was found to give good adhesion in contrast with poorer adhesion when cathodic cleaning was used.

Chemical Evaluation and Control in Metal Cleaning

By Jay C. Harris
Thomas & Hochwalt Laboratories Div., Monsanto Chemical Co., Dayton, Ohio.

Fundamental cleaning processes are described and the use of tetrasodium pyrophosphate in alkaline cleaners is described in detail. The advantages of this material are marked water softening activity, by "sequestration" of calcium and magnesium; lime soap regenerative action, by "sequestration" of calcium and magnesium; chemical stability in the presence of other alkalies, and marked ability to increase cleaning action when used with other alkalies.

Evaluations of cleaning materials are also made.

Pickling of Metals for Electroplating

By Owen T. Towner
Superintendent of Finishing, Auto Sun Products Co., Cincinnati, Ohio.

New equipment for pickling solutions

Dave Williard (left), popular Detroit Rex man with DuPont's Harry Benner (center); another DuPont man on right.

Fred Worch of Williamsville Buff in a confidential moment with Jake Hay. The back is Rudy Hazucha's.

is described. The author discusses the composition of oxide scales and their manner of removal in muriatic and hot sulphuric acid solutions. The advantages of inhibitors in acid solutions are discussed in detail. The danger of forming white dehydrated ferrous sulphate deposits from poor rinsing is mentioned. Other important factors of acid pickling and recommended mixtures as well as analyses of pickling solutions are given.

PLATING SOLUTIONS

Electrodeposition of Lead from Lead Acetate Solutions

By Dr. F. C. Mathers and J. Schwartzkopf

Indiana University, Bloomington, Ind.

Combinations of glue and cresol as addition agents were found to produce solid, thick, finely crystalline cathode deposits from lead acetate solutions containing sodium acetate and free acetic acid. The effect of the concentration of all the components has been outlined. A current density of 1.2 amp./dm.^{2} (11 amp./ft.^{2}) may be used. Thin deposits of lead 0.001" and 0.003" on steel were sufficiently adherent for soldering.

The following bath composition is recommended:

Lead acetate, $Pb(C_2H_3O_2)_2 \cdot 3H_2O$	10 grams
Sodium acetate, $NaC_2H_3O_2 \cdot 3H_2O$	12-16 "
Acetic acid, $HC_2H_3O_2$	2 "
Glue	0.4-0.6 "
Cresol (in a sodium hydroxide solution)	3 to 4 drops per 100 ml.

Studies in Bright Nickel Plating Processes

By Dr. C. B. F. Young

Electrometallurgist, Columbia University, New York.

An attempt was made to review the different types of bright nickel plating baths which are now on the market. The information was secured from the companies furnishing the processes, from plants using the processes, or from patent literature. All bright nickel companies were asked to cooperate in the compilation of the information contained in the paper. Of the six companies now selling bright nickel baths, only three aided by giving information concerning their product. The following questions are answered in the paper: composition of solution, addition agent and salt used, wetting agent used, surface tension, pH range, current density, temperature, impurity range, type of filtration, method of purifying solution, adaptations, adhesion of plate, throwing power, patent situation and type of racks needed.

A sample of all the bright nickels with one exception was obtained and a photomicrograph of each was made at about 650X both polished and etched. Striation lines occurred in several deposits. It was suggested that more work be done on these lines to determine their effect on the deposit, if any.

Silver Plating at Very High Current Densities

By A. C. Simon and J. T. Lumley

National Bureau of Standards, Washington, D. C.

A unique apparatus is described which was used in the study of silver plating solutions operated at high current density. It involved the passage of solution by the electrodes contained in an enclosed reservoir.

Some of the results were:

1. The permissible current density to produce smooth adherent deposits may be increased by:
   - Increasing the silver content of the bath
   - Increasing the content of free cyanide
   - Increasing the temperature
   - Increasing the agitation
2. Under favorable conditions, with good agitation, current densities of at least 200 amp./ft.^{2} (21.5 amp./dm.^{2}) may be used, at which over 0.0003" (0.0076 mm) thickness of silver may be deposited in one minute.
3. An increase in free cyanide generally decreased the porosity.
4. The porosity of silver applied over pore-free copper coatings is much less than when applied directly to steel or over a copper strike.
5. The cathode efficiencies under favorable conditions are from 60 to 70 per cent.

Study of Sodium Stannate Tin Plating Solution

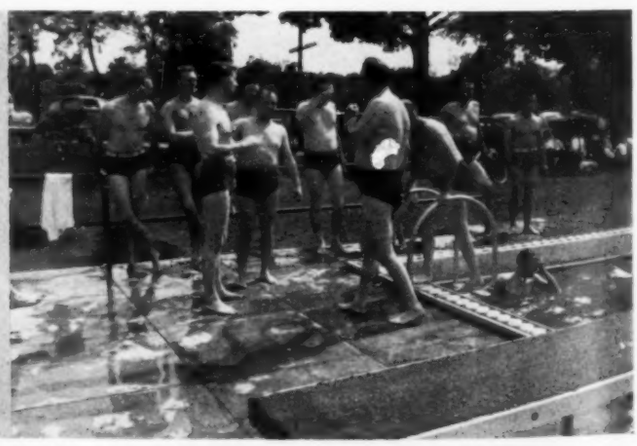
By Frederick Bauch

Frigidaire Corp., Dayton, Ohio.

Some of the conclusions drawn from this paper are:

1. Bivalent tin ions in a sodium stannate tin plating solution cause bulky, porous, and blistered deposits. For this reason they are not desirable.
2. The anodic behavior of tin in the sodium stannate solution is more constant when the free causticity is held above 1 oz./gal. The addition of 2 oz./gal. of sodium acetate improves this condition.
3. A hydroxide film forms on the tin anode in an alkaline tin solution when the current is off. Unless this film is removed by an initial increase of the current density, the tin is dissolved as stannate. This high current density is required for a short period only and it is desirable to reduce the current later to a practical value, in order to obtain a high anode efficiency. Unless the source of electrical energy is designed for an overload, it must be of greater capacity than required for actual operation.
4. The anode current density must be maintained within a certain range. The optimum current is used when the anode is coated with a yellow, greenish film and the gassing at the anode is slight. It is difficult to maintain this condition when tank load varies greatly. For this reason, the solution should be operated with full tank loads only, and on plating machines, dummy cathodes should be used for any missing load.
5. An excess of bivalent tin ions may

Lester Smith and Paul Pine of Harshaw Chemical Co., Cleveland, Ohio, snapped in front of the excellent Auto-Lite Co. exhibit.



Glamour boys, mostly from Lea Manufacturing Co. showing their torsos. Left to right, Dr. Hank Kellner, Art Wood (Westinghouse), Dick Crane, Earle Couch, D. Moser, don't know, Bob Green (Alsop), Bob Leather, Fred Fulforth, don't know. Editor in water.

be observed in the color of the bath. It is best to operate the solution so that no stannite is formed. The formation of bivalent tin ions is accompanied by a low potential across the solution. This phenomenon may be used as an indicator.

6. Excess oxidizing agents lower the cathode efficiency and may attack the ware, especially brass or copper immersed in the solution when the current is off. Oxidizing agents should be diluted and added to the solution with vigorous stirring.

7. The above conclusions show that a sodium stannate bath may cause considerable difficulties as the bath can only be operated within a narrow range. This requires a fairly constant load. The best method is to keep the bath fully loaded and to replace ware removed from the tank as it is removed, rather than load and unload the entire tank.

In tanks such as continuous plating machines, better results are obtainable if the load is fairly constant. If not loaded fully, dummy cathodes have to be used on carriers to take up the missing load. These dummy cathodes may be used later as anodes and deplated.

8. The composition of the tin plating solution may be maintained through proper balance. It is more economical to plate the tin from the anodes instead of from the stannate.

9. It is of a definite advantage to have the tank containing the solution lined with a non-conducting material to eliminate galvanic cell action. This will also prevent the possibility of the tank acting as anode or intermediate cathode.

The Cathodic Treatment of Copper in a Solution of Beryllium Sulphate to Prevent Tarnishing

By Dr. D. T. Ewing and George W. Jernstedt

Michigan State College, Lansing, Mich.

Pioneer work of Thomas and Price has been extended in this excellent paper. The summary of the extensive work on the deposition of beryllium hydroxide deposits is as follows:

1. Copper may be treated cathodically in a solution of beryllium sulphate and ammonium hydroxide to give it excellent protection against oxidation in air at elevated temperatures or tarnishing from sulphur fumes.

2. Deposition is made from a bath containing 3 to 4 g/l of beryllium sulphate nearly neutralized with ammonium hydroxide. The film is probably composed of colloidal beryllium hydroxide which has a positive charge in solution and migrates towards the cathode when a potential is applied.

3. The addition of 3 to 5 g/l of boric acid to the bath causes coagulation of the larger colloidal particles. This leaves the smaller particles to be plated out, which aids in forming a transparent and colorless film.

4. General operating conditions include: anodes of 7% tin and 95% lead, a current density range of 50 to 100 ma./sq. ft. for a period of 4 to 6 minutes, the pH of the solution is initially adjusted to between 5.5 and 5.9 and may be operated as low as a pH of 4.9. Dry film carefully and heat a few minutes at 275-300° C.

5. The film is limited to a thickness of approximately 4 millionths of an inch, this being attained after the maximum potential has been reached during electrolytic treatment. The film, although limited to this small value, will withstand rubbing with non-abrasives, the main weakness being its low resistance to mechanical abrasion.

6. The peak voltage is an indication of the protective power of the film only for a given current density and bath composition. Otherwise the two factors are not related.

Hard Plating Plastic Molds

By A. Logozzo

Foreman Plater, Plastics Div., General Electric Co., Pittsfield, Mass.

The author opens his paper with a discussion of plastic materials and reasons for plating of molds used in forming plastics. Chromium plating of molds has been found to reduce wear on the mold, giving much longer life and also a considerably shorter breaking in period. Corrosive attack by the chemicals in the plastics is also markedly reduced.

The various operations in the plating cycle are described in detail, such as polishing, cleaning, which involves cathodic alkaline cleaning followed by anodic treatment in chromic acid. A minimum file-hard thickness of 0.001" is required. The 400 grams per liter chromic acid solution is recommended and is operated at 113° F.

In addition to the advantages mentioned above for chromium plating plastic molds, higher finish of the molded part, better flow of compound and better uniformity of molded pieces are other advantages.

Magnesium as a Control Agent for Zinc Anodes

By R. O. Hull

Electroplating Division, Experimental Laboratory, E. I. duPont de Nemours & Co., Inc., Cleveland, Ohio.

A serious problem in zinc plating, particularly bright zinc plating, is the control of the anode efficiency to prevent metal build-up and to prevent solid particles from floating in the solution. It was found that both calcium and magnesium will control the zinc anode efficiency and the reduction of the anode efficiency is in proportion to the amount of these materials in the anode, used either together or separately. For example, 0.18% of magnesium in high purity zinc will reduce the anode efficiency from 100% to about 84%. For anodes containing metallic impurity, such as lead, less magnesium is required. Calcium is not as effective as magnesium, and for example, 1% of calcium is required to reduce the anode efficiency to 88% as compared with 0.16% of magnesium.

Magnesium was also found to be of value in mercury-zinc anodes. The use of magnesium and calcium in zinc anodes markedly reduces the amount of sludge or solid particles which may be suspended in the solution and cause rough deposits.

TESTING

Notes on the Spot Test for Thickness of Chromium Coatings

By Dr. Wm. Blum and W. A. Olson

National Bureau of Standards, Washington, D. C.

The hydrochloric acid spot test for determining thickness of chromium coatings was investigated in detail. Data are given on the specific gravity of various hydrochloric acid concentrations, and it was found that the rate of solution of the chromium coating varied markedly with the concentration of acid.

A correlation was shown between the works of Strausser, Pinner and Sperry when plotted under identical conditions.

Curves are given for the effect of concentration on stripping rate and the effect of temperature on stripping rate.

A recommended procedure for the spot test is given which involves marking a spot with a wax crayon, cleaning the spot with magnesium oxide, and the use of hydrochloric acid of 1.180 specific gravity.

This solution will dissolve 0.00001" of chromium in 10 seconds at 78° F. Corrections are given for other temperatures.

GENERAL PAPERS

Plating Shop Economics

By Dr. M. M. Beckwith

J. B. Ford Sales Co., Wyandotte, Mich.

A practical paper discussing various points to be considered for economical plating. The fallacy of calculating barrel plating costs on a weight basis is described. Other suggestions to reduce costs are:

1. Reduction of lost motion or effort by the proper arrangement of tanks, and in some cases, re-arrangement of existing systems when new labor facilities are employed.

2. Proper study of buffing compositions and cleaning materials on their ultimate cost rather than initial price.

3. The use of gloves and proper protection of employees.

4. Proper insulation and design of racks to save on plating rack material, and metal plated on the racks.

5. Proper rinsing.

6. Cleaning generators and more attention to their sources of troubles.

7. Safety and good housekeeping.

The author recommends that each plating room have an auxiliary tank for experimental use, such as for investigation

of new cleaners or other materials used in the plating room.

Our Patent System and the Electro-Processing Industry

By H. A. Toulmin

Toulmin & Toulmin, Attorneys, Dayton, Ohio.

A discussion of our patent system with a flow diagram illustrating the procedure for patenting in the Patent Office. Examples of various patent decisions are given to demonstrate the vicissitudes of patent litigation.

The advantages of the patent system to American industry are thoroughly discussed.

Disposal of Plating Room Wastes

By T. J. Fadgen

Process Engineer, Ternstedt Trenton Div., General Motors Corp., Trenton, N. J.

This problem is becoming of increasing importance due to the national program for purification of streams. The installation at the Ternstedt Mfg. Corp., Division of General Motors Corp., is described.

This unit contains two concrete retention tanks of 115,000-gallon capacity which allow a brief settling time for the solids. Special troughs are employed to skim oil from the surface of the tanks. Facilities are available for the neutralizing of water by limestone previous to its entry into the tanks.

The exhaust from metal polishing lathes is washed to free it from dust and lint. A special disposal house is available for handling 6,000 gallons of cyanide solution. The treatment consists of pouring in sulphuric acid and exhausting the hydrogen cyanide through a 100-ft. stack under a high velocity of air.

TECHNICAL ASPECTS

Metallurgical Aspects of Hydrogen in Electroplating

By C. A. Zapffe and C. L. Faust

Research Associate

Research Engineer, Battelle Memorial Institute, Columbus, Ohio.

Fundamental and experimental considerations of hydrogen in metals, particularly in steel, are discussed from a metallurgist's viewpoint to convey to the electroplating industry some of the important results obtained in recent metallurgical researches on hydrogen in steel. The tremendous effect exerted by hydrogen on metals is briefly explained and metallurgical data for hydrogen-metal reactions during acid pickling and cathodic electrolysis are presented to supplement those already known by electroplaters.

The importance of hydrogen absorption by steel to electroplated ware is demonstrated by experiment to show that lifting and blistering, and possibly poor adherence, may be caused by this gas through its effusion from the steel base at ordinary temperatures, and that occurrence of the defects is especially favored by heating. Effusion of the gas from the steel base during electroplating is a cause of gas pits, because it is difficult for metal ions to deposit over small holes through which gas is continually escaping.

Embrittlement and hardness of electrodeposits are discussed, and an explanation is afforded for the descaling action that occurs during cathodic electrolysis. Hydrogen absorption is shown to be severe during cathodic cleaning in either acid or alkaline solutions. Suggestions are made for preventing hydrogen-caused defects in electroplate.

A Short Research on the Effect of Basis Metal Polishing on the Character of Nickel Plate

By W. L. Pinner

General Spring Bumper Div., Houdaille-Hershey Corp., Detroit, Mich.

Three different types of steels, namely, hot rolled bumper steel; commercial cold rolled steel, and "perfect" cold rolled steel were subjected to different polishing procedures with grits varying from 90 to 220 mesh and 0.001" of nickel was applied from a modified Watt solution.

Salt spray tests were made on the various panels to evaluate their relative porosity. It was found that the polishing grit size and procedure had a marked influence on the porosity of the nickel coatings as was previously shown by Phillips some years ago. The coarser grit sizes tended to cause more porous nickel coatings and final finishing with a 220 grease wheel gave superior results. It was indicated that scratch elimination was not definitely necessary so long as a smooth effect is obtained on the scratched tops combined with some diminution of scratch depth and width.

A Method for Studying Cathode Films by Freezing

By Dr. Abner Brenner

Chemist, National Bureau of Standards, Washington, D. C.

A unique method is reported for the study of the partly depleted film which forms adjacent to the cathode during electrolysis.

The method consists of rapidly freezing the solution adjacent to a round cathode using a mixture of solid carbon dioxide, chloroform, and carbon tetrachloride. Layers of the frozen solution may be turned off on a lathe so that analyses of the film several thousandths of an inch from the cathode are possible. In the case of nickel solution, it was found by extrapolation for a solution containing 53 grams per liter of nickel that the cathode film at approximately 10 amperes per sq. ft., may be depleted in nickel to a concentration of approximately 33 grams per liter of nickel, immediately adjacent to the cathode.

The thickness of the partly depleted film was found to be 0.012" which is somewhat less than the commonly accepted value of about 0.020". Comparisons with the drainage method indicate equivalent results. However, the results by the freezing method are approximately 5 times as much as those reported by Graham and Read.

Effect of Moving Cathodes

By W. M. Phillips

Head, Electrochemistry Dept., Research Laboratories Div., General Motors Corp., Detroit, Mich

A report on a short study on the effect of cathode motion on maximum current density for acid copper plating baths. Increase in cathode movement and in temperature effected a marked increase in the current density limit. With a copper sulphate content of 150 g/l and concentrations of sulphuric acid of 5, 10 and 15 g/l, the maximum current density is the same for stationary cathodes, namely, 24 amperes per sq. ft. A movement of 10′ per minute raised the maximum permissible current density to 60 amperes per sq. ft. and with 50′ per minute movement, the maximum permissible current density moved up to 72 amperes per sq. ft. It was found that a temperature of 130° F. was more favorable than 180° F. Raising the temperature of the aforementioned solutions from 75° F. to 130° F. raised the maximum allowable current density for unagitated cathodes from 25 amperes per sq. ft. up to 48 amperes per sq. ft. At 50′ per minute movement, the maximum current density limit was 96 amperes per sq. ft.

Higher concentrations of copper sulphate with wider ranges of sulphuric acid were studied with little change in results over those mentioned.

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Other papers presented which were not pre-printed, and which have not been reviewed were:

The Trends of Electroplating. By George B. Hogaboom, Hanson-Van Winkle-Munning Co., Matawan, N. J.

Treatment of Steel Prior to Organic Paint Finish. By S. J. Colvin, Parker Rust-Proof Co., Detroit, Mich.

The Relative Effect of Various Polishing Finishes on Corrosion Resistance of Electroplated Nickel Deposits on Steel. By the Toledo Branch.

New Equipment for Treating Parts in Bulk. By Gustaf Soderberg, The Udylite Corp., Detroit, Mich.

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From early colonial times to the present, Bolivia has supplied more than $4,000,000,000 of silver and several times that amount of gold.

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The United States Treasury's gold holdings have passed the $18,000,000,000 mark. This country now holds over 66% of the whole world's gold stock. Since 1934 when the dollar was devaluated, the United States has imported a stock of gold worth over $9,000,000,000.

The Determination of Silver In Silver Cyanide Plating Solutions

By Daniel M. Gillies and Wallace M. McNabb

Department of Chemistry and Chemical Engineering, University of Pennsylvania, Philadelphia, Pa.

A method is described for the titration of silver in a silver cyanide plating solution after the removal of cyanides with sulfuric and nitric acids. The method consists in titrating the silver with a standard potassium iodide solution, using ceric ammonium sulfate and starch as indicators. Results obtained by the iodide method compare favorably with the Volhard method.

Results have been published showing that silver may be determined accurately by titration with standard potassium iodide solution, using ceric ammonium sulfate and starch as internal indicators.[1 2 3] The advantages of this method over the Volhard method led the authors to investigate its further application, namely to the analysis of silver in silver plating solutions.

In the Volhard method the thiocyanate solution must be standardized against pure silver or silver nitrate, whereas a standard potassium iodide solution may be prepared by weight, thus making a standardization unnecessary. Also the end-point obtained in the iodide titration is sharp and easily seen, which eliminates one source of uncertainty found in the thiocyanate method.

Experimental Procedure and Results

Sufficient pure, dry potassium iodide to give a 0.1 N solution was weighed, transferred to a liter measuring flask and diluted to the mark. Solutions of known strength of pure silver nitrate were similarly prepared. Accurately measured volumes of the silver nitrate solution were transferred to 250 ml. erlenmeyer flasks. To these were added 20 ml. of 6 N sulfuric acid and sufficient water to make up a total volume of 120 ml. (This gives a solution about 1 N to acid.) After the addition of 3 drops of an approximately 0.1 N solution of ceric ammonium sulfate and 3 ml. of 1% starch solution, the silver was titrated with the standard potassium iodide solution to the first permanent blue-green color. Blank titrations were made under identical conditions omitting the silver ion. Results are given in Table I.

Since the silver solution resulting from the decomposition of a silver cyanide plating solution with acid contains considerable sodium sulfate, together with a relatively high concentration of sulfuric and nitric acids, titrations were made on samples of pure silver nitrate solution, to which were added 15 ml. of 18 N sulfuric acid, 5 ml. of concentrated nitric acid and 2 grams of sodium sulfate. The volume titrated was again 120 ml., giving an acid concentration of about 3 N. Results are given in Table I.

Table I

(a) Analysis of pure silver nitrate in 1 N acid solution

Ag taken gram.	Ag found gram.	Difference gram.
0.3690	0.3693	+0.0003
	0.3690	±0.0000
	0.3688	—0.0002
	0.3687	—0.0003
0.2158	0.2160	+0.0002
	0.2158	±0.0000
	0.2158	±0.0000

(b) Analysis of pure silver nitrate in 3 N acid solution. 2 grams of sodium sulfate added to each sample.

0.3690	0.3692	+0.0002
	0.3695	+0.0005
	0.3689	—0.0001
	0.3688	—0.0002

A typical silver plating solution, such as is used in practice, was made up with the following composition:

$AgNO_3$	38.7400	grams per liter
NaCN	44.4	" " "
Na_2CO_3	49.2	" " "

Ten or 15 ml. samples of the silver plating solution were accurately measured into 250 ml. erlenmeyer flasks. Five ml. of concentrated sulfuric acid and 5 ml. of concentrated nitric acid were added and the solutions boiled until clear. The solutions were then diluted with 100 ml. of water and cooled to room temperature or below. After the addition of 3 drops of ceric ammonium sulfate indicator, standard potassium iodide solution was run in from a buret until the end-point was approached within one or two ml. Then 3 ml. of 1% starch solution were added and the titration continued to the first permanent blue-green color. Blank titrations were made in all cases. The results are given in Table II.

Since it is customary to use small amounts of carbon disulfide as a brightener in silver plating solutions, certain analyses were made in which 1 drop of CS_2 was

added to each sample of the plating solution. Results are given in Table II.

Table II

(a) Analysis of a typical silver plating solution.

Ag taken gram.	Ag found gram.	Difference gram.
0.2460	0.2458	—0.0002
	0.2460	±0.0000
	0.2457	—0.0003
	0.2460	±0.0000
	0.2463	+0.0003
	0.2462	+0.0002
	0.2457	—0.0003
	0.2459	—0.0001
	0.2461	+0.0001
	0.2456	—0.0004
0.3690	0.3686	—0.0004
	0.3688	—0.0002
	0.3693	+0.0003
	0.3690	±0.0000
	0.3691	+0.0001
	0.3685	—0.0005
	0.3686	—0.0004

(b) Analysis of a typical silver plating solution. One drop of carbon disulfide added to each sample.

0.3690	0.3690	±0.0000
	0.3685	—0.0005
	0.3695	+0.0005
	0.3689	—0.0001

The end-point obtained in this titration is presumably due to the following reaction, which takes place in an acid medium.

$$2Ce^{++++} + 2I^- \rightleftarrows 2Ce^{+++} + I_2$$

However, if the acid concentration is much above 3 N, a satisfactory end-point is not obtained, the typical blue-green color rapidly changing to brown or purple. This is probably due to decomposition of the starch iodine complex in the presence of a high concentration of electrolyte. It is important, therefore, to regulate conditions so that the solution titrated shall be less than 3 N with respect to acid. In the above procedure, the solution, after dilution, is about 2.2 N to acid.

Since a slight excess of iodine ions is necessary to give a permanent reduction of ceric ions, it is essential to run a blank on the indicator. For greatest accuracy, the blank titrations should be made under the same conditions omitting the silver nitrate. The blank was found to vary with the volume of solution titrated. Using the procedure outlined above, the blank consumed about 0.10 ml. of KI solution, but when the titration was made in a volume of 180 ml. a blank of 0.15 ml. was obtained.

For comparison, analyses of the silver plating solution were also made by the Volhard method. Hillebrand and Lundell[4] state that the presence of sulfates is undesirable, since silver sulfate may be carried down in the thiocyanate precipitate. However, satisfactory results were obtained, even in the presence of a large excess of sulfuric acid. Samples of the cyanide solution were decomposed according to the procedure already given, except that in some cases as much as 20 ml. of concentrated sulfuric acid were used. The solutions were diluted to a volume of 120 ml. and the silver titrated with standard thiocyanate solution.

Table III

Analysis of a silver plating solution by the Volhard Method

(a) In the presence of 5 ml. of Concentrated Sulfuric Acid.

Ag taken gram.	Ag found gram.	Difference gram.
0.2460	0.2459	—0.0001
	0.2460	±0.0000
	0.2456	—0.0004
	0.2456	—0.0004

(b) In the presence of 20 ml. of Concentrated Sulfuric Acid.

0.2460	0.2456	—0.0004
	0.2457	—0.0003
	0.2457	—0.0003
	0.2455	—0.0005

Summary

A method is described for the titration of silver in a silver cyanide plating solution after the removal of cyanides with sulfuric and nitric acids. The method consists of titrating the silver with a standard potassium iodide solution, using ceric ammonium sulfate and starch as indicators. Results obtained by the iodide method compare favorably with the Volhard method.

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The world's largest silver producing mine is located at Pachuca which is about sixty miles north of Mexico City, Mexico. Other metals, such as zinc and lead, are produced mainly as by-products of silver.

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Every time you telephone you talk through precious metals, gold, platinum and silver in more than 20 alloys used in special metal contact points.

•

The largest lump of silver ever found was discovered by an Indian in Sonora, Mexico, when that province was still a posession of Spain. The lump weighed 2750 pounds.

•

All the monetary gold in the world today, if melted into a single block, would form a cube 33½ feet on a side—a cube weighing 22,238 tons. It would be worth $23,212,000,000.

•

Nero's wife, Poppa, is said to have had her mules shod with shoes of solid gold.

Rectifiers For Electroplating

By Clarence C. Helmle

Chemical Engineer,
General Electric Co.,
Bridgeport, Conn.

Clarence C. Helmle

An outline of the methods of making copper oxide rectifiers. A comparison with motor-generators is made on operating and overall efficiency.

The process of rectification, or the direct conversion of alternating current into direct current, is not new nor are the means by which rectification may be accomplished, the phenomenon having been observed with certain electrolytic films as far back as the middle of the ninteenth century. Of the various types of devices capable of such an accomplishment, the electroplating industry has become primarily interested in the junction type, represented by the copper oxide rectifier. This arises from the fact that the junction type of rectifier is the only one that appears to be practically capable of converting permanently the large currents commonly employed.

It might be further stated that the copper oxide rectifier itself is not new having been discovered during the early part of 1920. Since that time, they have been tried and proven on such applications[1] as battery charging, magnet and solenoid operation, motion picture projectors, radios, telephone, telegraph, time clocks, elevator controls, and motor starters, to mention only a few. A typical group of such units is shown in Figure 1. It is, perhaps, the application to electroplating which is new rather than the rectifier, at least in the United States, since rectifiers have been in such use in England longer than in this country. Thus we see that the principle of rectification and its application to the field of electroplating is not theoretical conjecturing but a concrete possibility backed by years of excellent service in the above-mentioned fields of application.

The discovery of the cuprous oxide rectifier was dependent upon the observation that a film of red cuprous oxide in intimate contact with copper will allow current to pass readily in one direction but with considerable difficulty in the opposite direction. No positive theory has been advanced to explain why it is possible for large numbers of electrons to flow from the copper to the oxide film but relatively few in the reverse direction. Since the flow of electrons in a conductor is in a direction opposite to the flow of current, it is obviously possible to pass current only in the direction of oxide to copper. This is descriptively known as a "valve action".

Making Copper Oxide Discs

The above-mentioned observations were put into useful practice in the copper oxide rectifier by heating copper discs or washers in a controlled atmosphere furnace just below the melting point of copper, resulting in the formation of a layer of cuprous oxide. The atmosphere and the load in this furnace must be carefully controlled in order to utilize the proper proportion of oxygen. After

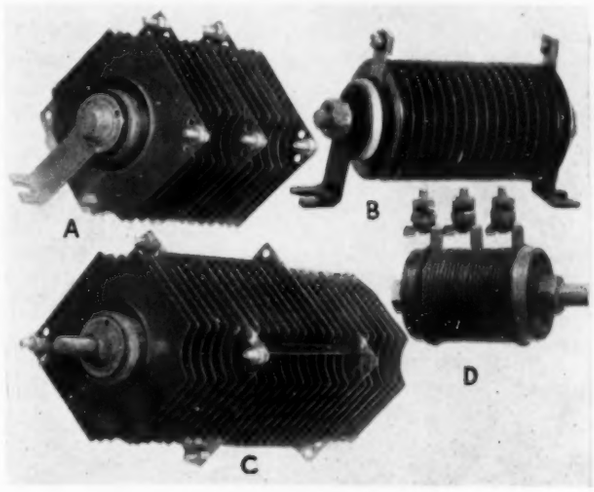

Fig. 1. Various types of copper oxide rectifier units. A. Full-wave 5-terminal type, with brackets; B. Rectifier for industrial control application; C. Full-wave type, 2 units in multiple; D. Rectifier for industrial control apparatus.

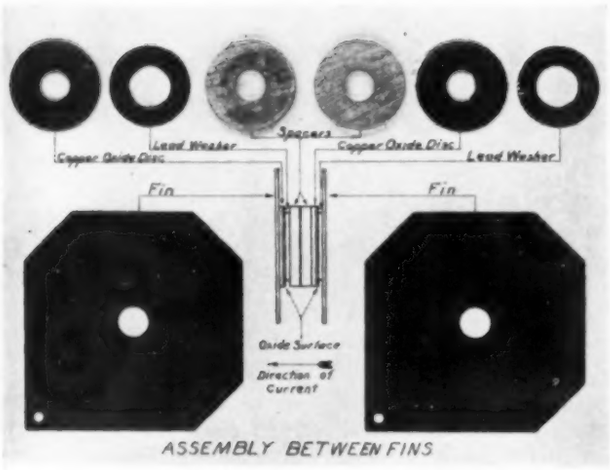

Fig. 2. Sequence of assembly of rectifying discs.

being transferred to, and held in another furnace at a somewhat lower temperature, the washers are quenched in water. It is interesting to note that the best method thus far found for determining the moment at which quenching should take place is dependent upon the operators' experience in waiting for and detecting a particular color change on the surface of the washers after they have been removed from the furnace. Despite rigidly controlled operating conditions, it is not possible to eliminate the formation of cupric oxide on the surface of the washer. This oxide is either stripped or converted depending upon the particular piece of equipment of which it will ultimately be a part. This is considered later in this discussion.

Mechanical Construction

The oxide coated washers are then alternately stacked on an insulated bolt with lead washers, spacing washers, and larger circles or squares of a non-ferrous material which are known as heat radiating fins, the arrangement being such as to always have a lead washer on each side of the rectifying washer. The sequence of assembly is shown in Figure 2. The entire assembly is bolted together under very great pressure. The lead washer and high pressure are employed to obtain minimum contact resistance between the two washers. It is obviously impossible to use very large washers because of the correspondingly greater pressures required. These small formed washers have the black cupric oxide removed from their surfaces by means of a solution of an acid or alkali before they are assembled as described above.

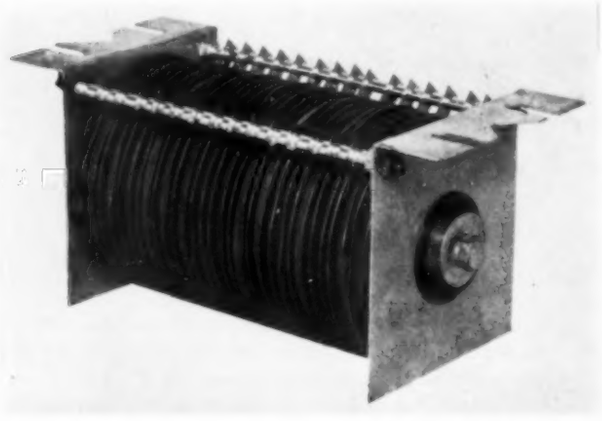

Fig. 3. Typical plate type rectifier for electroplating.

Plate Type

An arrangement such as the above, limits the size of the washers to about 1½" diameter thus limiting the rectifier in so far as high K.W. output, such as normally required for commercial electroplating applications, is concerned. In the case of rectifiers for electroplating applications, the output limitations of the washer type of assembly have been overcome by two methods, resulting in each case with a rectifier known as the "plate type". One method uses 5" x 4½" square or 4½" round plates of copper with a hole in their centers and which are "formed" as described above. However, instead of removing the black oxide of copper, it is reduced, along with a small amount of red oxide, to metallic copper and subsequently nickel plated. Nickel plating the plate makes it possible to achieve an excellent moisture proof contacting surface which eliminates the necessity of having the lead washers cover the entire surface. These plates have the red oxide formed on both sides and although it is possible to utilize them in such condition, in this type, the coating is completely removed from one side. It has been found that such practice, along with the center hole makes for ease of assembly and a neat compact unit. Contrary to expectation, there is no great advantage electrically in using the red oxide on both sides of the plate. Very little increase in output is possible due to the fact that the heat radiating surface is not increased proportionately but rather remains constant, and so approximately 40% reduction in the plate current density is necessitated. After assembling on a bolt along with washers and radiating fins, the entire assembly is given a moisture, alkali, acid, and heat resisting organic coating, thus rendering the unit suitable for resisting any normal plating room atmosphere. A typical plate type unit is shown in Figure 3.

The other method[2] mentioned involves the "forming" of rectangular plates of copper, and after stripping the black oxide, coating them first with finely dispersed graphite and secondly with a lead alloy by the metal spraying process. This method also results in a good contacting surface. The red oxide is not stripped from one side in this case but rather the two oxide surfaces are paralleled by a spring clip running the length of, insulated from, and extending around the two longer sides. The two clips are connected at one end by a strap with a hole in it for the assembly connections. There is also a hole in the plate at the opposite end surrounded by a circle of exposed copper to facilitate assembling on the rod which constitutes the other side of the supply conductors.

It should be noted that practically the same area of rectifying junction can be incorporated in a given space by either method. It will also be observed that, as compared with the washer type of assembly, neither of these methods depend fundamentally on pressure for bringing the entire oxide surface into service.

Magnesium Copper Sulphide Type

There is also still another type[3] of rectifier available which is fundamentally of the washer type of construction. In this case, the cooling fins are large circular rings; thus when the assembly is completed, the stacks of rectifying washers are arranged vertically in a circle, with the cooling rings one above the other. Such an arrangement facilitates uniform cooling. This rectifier uses a magnesium copper sulphide junction made by forming together a magnesium washer and a washer consisting almost entirely of copper sulphide. It is claimed that unusually high current densities and operating temperatures are permissible with this junction.

Voltage Control

It has been found that the copper oxide rectifiers have a negative coefficient of resistance and so as the temperature increases the current in the forward direction increases as does also the slight back leakage normally present. Thus, in order to prevent burning out the units and make possible compact assemblies, it is necessary to cool the rectifiers. This is accomplished by means of ventilating fans which force air over the elements when the apparatus is in operation. A wind relay switch is provided which automatically disconnects the rectifier when the fans fail to operate.

The conventional rectifiers in addition to the overload and short circuit protection devices commonly used on electrical equipment, contain a step-down transformer with a sufficient number of taps on the high voltage side to give practically any desired potential on the low voltage side.

The most common method of connecting the elements in rectifiers is known as a "bridge connection" and is depicted in Fig. 4. Although it is possible to operate rectifiers on single, two, or three phase circuits, wherever possible it is advisable to use three phase current since there is less ripple and higher efficiency. Most standard equipment is connected for three phase operation only, the primary voltages generally being either 220 or 440 volts at 60 cycles.

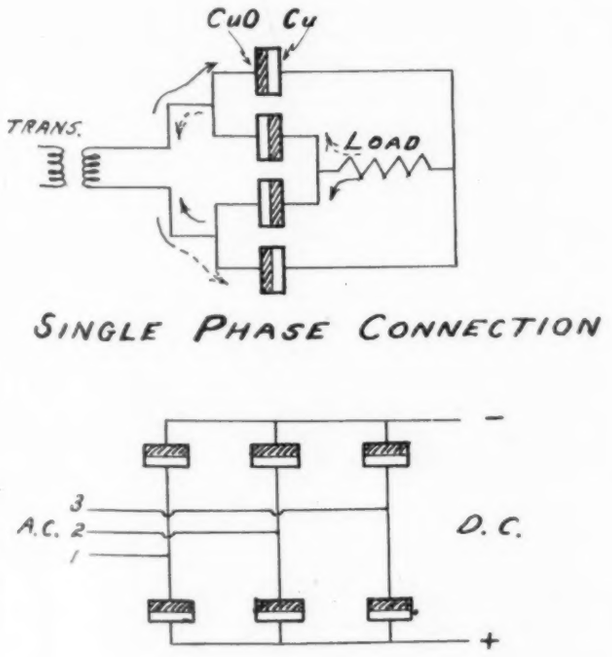

Fig. 4. Typical connections for rectifier units.

The method of controlling the voltage, as previously indicated, is simple and convenient consisting as it does of coarse and fine taps on the primary side of the transformer. Such an arrangement makes it possible to choose plating voltages which may vary by only ¼ of a volt. Obviously, to avoid short circuiting the transformer, it becomes necessary to momentarily interrupt the current when changing voltages. When such an interruption is not permissible, it is possible by using another small transformer to maintain a small current flow at all times and to complete the necessary adjustment by means of the various taps on the larger transformer. It is also possible to make uninterrupted adjustments by using a two armed contactor on the tap changing switch having sufficient resistance connected across the arms to protect the transformer, and so arranged that one arm will engage the tap immediately before the other disengages the tap in use. When several units are used in parallel, uninterrupted adjustments may be made by alternating the adjustments on each rectifier step by step.

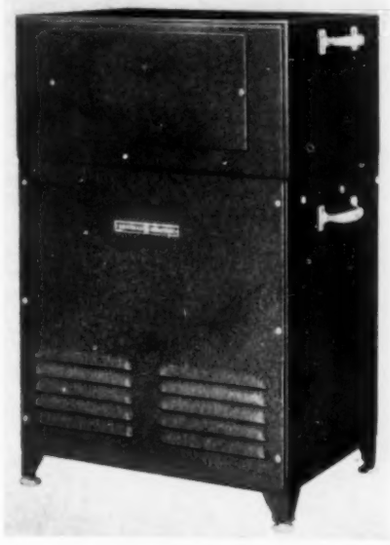

Fig. 5. Standard 300-ampere electroplating rectifier.

Electroplating rectifiers are obtainable in units ranging from 50 amperes to 10,000 amperes although demands up to 2,000 amperes are very often met by arranging several 200, 300, or 500 ampere standard units in parallel. A standard 300 ampere rectifier is shown in Figure 5. Although any desired voltage may be obtained, 6 volts and 12 volts have been practically standardized.

Performance Qualities

Electrically, the rectifier compares favorably with the conventional motor-generator set. Before considering cold figures on performance, it should be pointed out that much depends upon the practical interpretation of the data. Whereas the modern synchronous motor-generator

set has voltage regulation, or a voltage drop between no load and full load, of not over 3%, the copper oxide rectifier closely approximates 25% at 6 volts. The magnesium copper sulphide rectifier has a regulation of 15% at 6 volts. As might be expected, the efficiency of the apparatus, or the ratio of the D.C. power (watts) obtained to the rms. A.C. power (watts) used, will be somewhat lowered because of the above-mentioned regulation. The overall efficiency of the magnesium copper sulphide rectifier is between 50 and 55% at full load and is maintained down to 30% of full load. The copper oxide rectifier has an overall efficiency of approximately 70% at 6 volts and full load. This efficiency drops to about 60% at full load on 3 volts, although all of the curves fall between 60-65% at 25% of full load.

These figures would then indicate that the motor generator set is more efficient when operating at 6 volts and full load than a similarly rated rectifier while at lower voltages, the efficiencies may be equal or even reversed, inasmuch as there are no fixed losses such as brush and bearing friction in rectifiers.

When analyzing the above data, we should make the following considerations. The method of application of generator sets, wherein several plating tanks operate at different voltages from a common bus, is well known. It is important to remember that the voltage on each

Fig. 6. Standard voltage regulator for remote control.

tank is controlled generally by individual tank rheostats, in other words, by heat loss in a resistance. Hence, when we adjust the rheostat to give, say, 3 volts we are decreasing the operating efficiency approximately 50%. The recommended application of rectifiers advises a suitably rated unit for each tank. Such an arrangement makes possible practically full load efficiency since the equipment can be shut down when the tank is not in use. likewise, the voltage of the rectifier may be adjusted to operate at that required, and so eliminate the inherent losses of the tank rheostat. Since the voltage regulator may be located adjacent to the tank while the rectifier is placed at some more suitable location, all of the above is accomplished with a minimum of effort at the tank. A standard voltage regulator is shown in Figure 6.

Thus we see that if a comparison of the efficiency of application is made between the two types of equipment much will be found in favor of the rectifier. Putting the case another way, we may say that when all the plating tanks are to operate continuously at the generator voltage this equipment will give an efficient performance while on the other hand, when a number of different voltages and intermittent operations are part of the existing conditions, there is much to recommend the rectifiers.

The power factor of this equipment is 90% and better, averaging 95%, which compares favorably with a synchronous motor-generator set, although it may not be adjusted to unity or leading power factor.

Ageing

Some comment has been made concerning the occurrence of a phenomenon in rectifiers known as "ageing". It appears that during the first part of the time that a rectifier is in operation there is a definite decrease in the output. This might indeed render the rectifier impractical were it not for the fact this process ceases after the first few thousand hours operation. It might also, if not taken into proper consideration, result in harm to the rectifier because of the probability that the applied voltage would be raised above the safe limit of operation in order to maintain the initial output. The ageing is apparently caused by some slight oxidation of the parts in contact with each other resulting in increased contact resistance. Likewise there is an unavoidable lessening of the assembly pressure due to the creep of the materials used. There also appears to be an increase in the resistance of the oxide and of the junction. Unfortunately, an increase in operating temperature increases the rate of ageing—another reason for fan cooling. Fortunately, due to the studies made on rectifiers over a period of years, it is possible to design and build rectifiers compensated for the effects of ageing, thus assuring that the rectifier will always deliver its rated output during its long life.

Neglecting the cooling fans, which are generally factory lubricated, there are no moving parts and hence no wear, noise, lubrication, or maintenance. There are no heavy moving parts, the weight being from ¼-½ the weight of a corresponding generator set, and so the necessity for a heavy foundation is eliminated. The parts of the rectifier may be arranged in almost any desired manner since the parts are not mechanically interconnected, thus resulting in the saving of floor space and making possible the remote control feature previously mentioned. A high efficiency of operation is possible by means of the remote control because the rectifier can be turned on or off instantaneously, regardless of load. With three phase operation the per cent ripple, or the ratio of A.C. ripple voltage to D.C. voltage, may be equal to or better than that of a similarly rated generator set. As the output ratings are increased above 5,000 amperes, the curves on the overall cost of the rectifier and generators approach each other.

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Brush Electroplating

By W. A. Fairlie

President, Rapid Electroplating Process, Inc.
Chicago, Illinois

For years, platers have used a simple sponge apparatus for spot plating to cover bare areas. New equipment has been developed in recent years for rapid deposition of plated coatings, equipment being of a portable nature and the soluton of gel-like consistency to insure easy application on all types of surfaces. In addition, lower porosity of brush plated coatings is claimed. The author discusses the technique of brush plating and its many applications.—Ed.

For years platers have tried various devices for repairing defective and worn spots in plated coatings. The method generally employed is to wrap an anode with cloth or sponge which is then dipped into the plating tank solution and applied over the defective spot. Only relatively thin coatings are applied in this manner and its use is restricted to plating shops. The liquid electrolyte also has a tendency to run and streak finished surfaces, making it undesirable for use in many cases.

The success of brush plating lies chiefly in the fact that the gel-like consistency of the electrolyte permits greater mass of solution over the spot to be plated and consequently a greater amount of metal is available for instantaneous deposition. The high viscosity of the electrolyte prevents running and streaking of finished surfaces and also permits its use in overhead and other difficult positions.

Brush Deposits Less Porous

Increased importance as to the practicability and efficiency of brush electroplating has been given to the process in recent reports of the American Silver Producers' Research Project, Washington, D. C., which states along with other extended comment ". . . brush plating will give thinner, non-porous coatings than any we have yet been able to obtain by standard plating procedure." Graphs prepared by this bureau show that a thickness of 0.0002" of silver applied by the brush method is equal in non-porosity to more than double the thickness plated from the tank solutions. In the opinion of engineers, freedom from pores is due to the greater density of the structure from the proximity of the surface being plated to the current supply and to the agitation of the solution adjacent to the surface by the action of the brush.

It is not claimed that the process supplants commercial production methods but rather supplements them and its limitations as well as advantages must be clearly understood if satisfactory results are to follow. Brush plating necessitates individual treatment of each article being plated and consequently is not applicable to production jobs where a large amount of brushing is required per piece of work involved. It is best suited to the plating of limited areas, worn and defective spots and is in successful use on a production basis for plating designs on various articles, through stencils and with the aid of masking tape.

Preparation of Surface

The preparation of the surface prior to plating depends on the type of finish finally desired. Limited areas lend themselves nicely to hand finishing methods where power buffing equipment is not available. Polishing, in most cases, can be done with an emery polishing stick or a cloth wrapped around a stick of wood and then saturated with brass polish. Degreasing can be done with a rag dipped in any degreasing solvent or scouring solution. The operation of brushing on the compound assists in

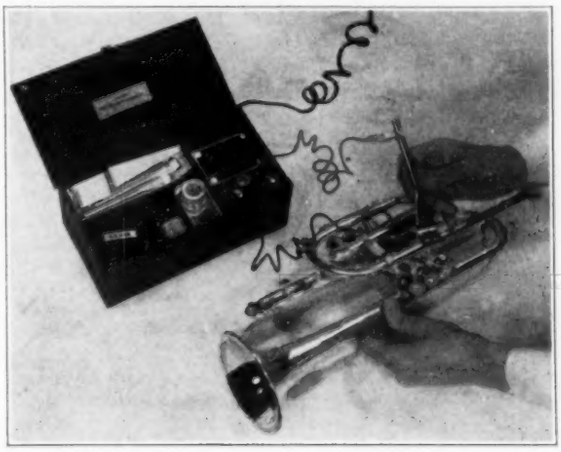

Illustration of the use of portable electroplating apparatus for spot plating of a trumpet.

overcoming surface tension effects and wets the surface much better than is the case with the aqueous bath and in silver plating, the application of the undercoat accomplishes the same purpose.

Simplicity of operations is the greatest single factor which gives brush plating an important place in the industrial arts. Operators without previous experience can obtain satisfactory results. The patented method of the Rapid Electroplating Process, Inc., 1414 S. Wabash Ave., Chicago, Ill., employs the following four basic steps:

1. *Prepare Surface.* This can be done with portable buffers or hand methods as explained above. In the case of electrical connections which are to be silver plated, a good polishing with fine emery paper is sufficient.

2. *Apply Undercoat.* This is brushed on before plating silver; in the case of other metals, the plating compound is first brushed on without current to form an air excluding film.

3. *Plate.* The plating brush or special applicator is dipped in the plating compound and with current connected is then passed over the surface at which time plating takes place. Direct current of 1½ or 3 volts is used, obtained from dry batteries or a special rectifier.

4. *Remove Compound.* After plating, the excess compound is washed or wiped off and surface dried and polished. No polishing of silver is necessary when plated on electrical connections.

Due to the high current densities permissible, a thickness of 0.0002" can be obtained with a few strokes of the brush or applicator. Heavier coatings are obtained by continued brushing and replenishment of compound. Brush plated coatings are as a rule somewhat denser, as explained before, than those obtained from the regular aqueous bath and in the case of nickel, considerably harder.

Uses for Brush Plating

Although other metals are available, silver has been found to have by far the largest field of application. In general, brush plating is adapted to the following uses:

1. Repair and maintenance of plated finishes. Here it provides a means for the immediate repair of damaged or worn spots before they have become so serious as to make repair difficult or impossible.

2. The plating of silver on contacting areas of many types of electrical equipment, where silver slugs are not required.

3. Plating of limited areas and small metal parts such as models, miscellaneous hardware, sample and test pieces.

4. Numerous special applications such as modifying resistances, coating welds and soldered joints, applying decorative stripes, bars, initials, designs, etc.

Although this method is generally known as "brush electroplating," it does not follow that the brush is the only applicator used. Because of the high metal content of the plating compounds, special applicators can be made from practically any metal that is a good conductor of electricity. These applicators are usually wrapped with one or two layers of cotton or silk cloth and are made of a size and shape to suit the work at hand. Nickel and steel have been found to be exceptionally well suited for this purpose, as with the particular formulae used, they have little tendency to plate out with the other metals.

A notable feature of the "Rapid Process" is the simplicity and inexpensiveness of the equipment employed, a typical complete kit requiring only plating compound, brushes, transformer-rectifier or batteries and the necessary connectors.

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Developments In Hot Dip Galvanizing†

By J. L. Schueler

General Superintendent
Continental Steel Corporation

Just a little less than a half million tons of slab zinc were used in the United States each year and, of this amount, slightly over 43 per cent is used for galvanizing. Approximately 52 per cent of this 43 per cent is used for galvanizing sheets, 17 per cent for hardware, structural purposes, etc., 15 per cent for tubes, 13 per cent for wire, and 3 per cent for wire cloth.* So, with such a substantial amount of zinc being used each year principally for hot dip galvanizing, developments are continually under way relating to processes and equipment to produce:

(1) Heavier coatings which are flexible and adherent;
(2) More uniform distribution of coatings. This involves improved coating apparatus and equipment;
(3) Improved practice and rigid metallurgical control.

When we produce hot dip galvanized coatings, we are generally manufacturing a product which has to meet certain specifications—if not the customer's, then our own shop or manufacturing standards. These specifications are determined by the limitations of the process involved in producing the material, as well as the material itself. As the process and product improves, the specifications tighten.

It is often true, and especially so in the field of galvanizing, that the tests involved in specifications are not thoroughly reliable, or else do not tell the whole story. For example, the Preece test for uniformity of coating is not positive or infallible, but it is the best which has been developed to date for the purpose and it is over fifty years old. It is true that the weight of coating test is accurate, but it is incomplete in that it does not show the distribution of the coating. Furthermore, with our present knowledge of coatings and lack of long-time correlated atmospheric corrosion data, no accelerated corrosion test tells us any more than that certain things might be expected to happen to a coating when exposed to that particular corroding medium under exactly the same conditions of test. When the present outdoor exposure tests now being conducted on galvanized coatings by the American Society for Testing Materials are completed (which will be many years hence), we may have some data upon which a satisfactory accelerated test may be devised. In the meantime, however, we do know, pretty well, that so far as resistance to atmospheric corrosion is concerned, a heavier uniform zinc coating will outlast a thinner coating, though in what relative proportion we do not yet know.

Zinc, as we all know, is a brittle metal in the cast state, which is its condition on hot dipped material, although a substantial amount of this brittleness may be removed by working the metal under carefully controlled conditions and within a relatively narrow temperature range. Some modification of this metallurgical characteristic of zinc has been tried with coatings on both sheets and wire and, while fairly successful under very carefully controlled conditions, has not yet proved to be economical or wholly practical.

Cleaning

In many instances, coatings peel or flake from the steel base due to insufficient adherence to the base metal and not because of the brittleness of the zinc. Many times these facts are confused in reporting defective coatings. It has been found that for the heavier types of zinc coatings, proper preparation of the ferrous surface is essential. A good proof of this is the fact that a heavy malleable coating of very pure zinc, no matter how it is applied, will not adhere to an improperly prepared steel base. The preparation of the base to receive the coating, be it for sheets, wire, tubes, hardware, hollow ware, or structural material, involves certain fundamentals depending on the character or condition of the surface, namely:

*Based on figures published in "Metal Statistics for 1940" by the American Metal Market, from the American Bureau of Metal Statistics.

†Address presented at 22nd Annual Meeting, American Zinc Institute, Inc., St. Louis, Missouri, April 30, 1940.

A. An oil or grease removing step, involving:
   1. Immersion in an alkali or the like, or
   2. Immersion in an organic solvent, or
   3. Exposure to an organic vapor or spray, or
   4. Heat, either with or without atmospheric control.

B. A scale, or oxide removing step, which may be:
   1. Immersion in acid
   2. Sand or grit blasting, or the use of etched rolls
   3. Immersion in a molten salt bath
   4. Electrolytically in a suitable electrolyte.

C. A fluxing step, which consists of:
   1. Immersion in a liquid flux, or
   2. Immersion in a molten flux.

For removing grease or oil by means of alkalies or the like, developments have included the use of the caustic alkalies; sodium carbonate, metasilicate and orthosilicate; borax; trisodium phosphate; and many others. Apparatus for handling these solutions is not a problem because none of them has any substantial effect on steel.

Developments have also taken place along the lines of organic immersion and vapor degreasing methods involving the use of some such material as trichlorethylene combined with a suitable stabilizer. The best containers for these organic solvents are made from galvanized sheets. These solvents have not yet come into use for wire, sheets and the like, on account of the cost involved, but are used in many instances for hardware and small parts.

The use of heat for removing oil and grease in either an oxidizing or reducing atmosphere has long been used for wire galvanizing processes, but only recently has it been developed for use in strip or sheet galvanizing. This means of grease and oil removal is especially effective for cold reduced strip, especially the last traces, after the strip has been cleaned with any of the alkaline cleaners.

Pickling

Developments in scale or oxide removal by means of acid have taken place principally in processes involving the continuous pickling of strip. Here, too, the trend has followed wire and narrow strip galvanizing practice. The developments have been directed towards improved equipment, such as rubber-lined steel tanks faced with acid-proof brick laid up in acid-resisting cement; improved practice, including anodic pickling and the use of automatic pickling temperature control; control of acid bath strength and composition, and tank arrangements to permit cleaning speeds running up to 150 feet per minute, and better, for some classes of material.

So far, in sheet pickling practice there appears to be no definite correlation between the practices in different shops, although a considerable amount of development work is now under way along these lines. Temperatures for strip pickling seem to run higher, say up to 190° F., than for sheet pickling which are more nearly 160° to 170° F. The continuous strip processes also use higher acid strengths, say to 12 per cent as against about 7.5 per cent for sheets. Sulfuric acid is used almost exclusively for these processes. In wire galvanizing, on the other hand, hydrochloric (muriatic) acid is used prior to the galvanizing operation and at very much higher strengths than the sulfuric for sheets, due to the speed of the wire travel and its relatively short time of immersion in the bath.

The use of grit blasting for sheets seems to be limited to gauges heavier than 20 and for material which is to be used for culverts and the like, and to which heavy coatings must be applied—that is, coatings heavier than 2 ounces per square foot. This type of apparatus has long been used for hardware and structural descaling and as a preliminary treatment for spray galvanizing, but until recent years it has not been suitable for sheets. The use of molten salt baths has been prevalent commercially in two processes of wire galvanizing and some development work along this line is now being carried on for sheets.

Anodic cleaning has come in for considerable development principally with electrogalvanized coatings, although it has been used for hot galvanized processes for sheets or wire with good results.

Fluxes

Liquid fluxes for galvanizing are predominately zinc chloride, although some zinc ammonium chloride is also used in hollow-ware shops. A great deal of work has been carried out to ascertain proper strengths and temperatures for use, but up to the present there is no definite practice to follow in this respect. These solutions should be kept as nearly neutral and as free from iron as possible, only sufficient acid being present to prevent precipitation of basic salts.

Ammonium chloride and zinc ammonium chloride are the principal materials comprising molten fluxes. There appears to be a difference in results obtained from the use of these fluxes as obtained from different manufacturers, and also variations depending on the size of the crystals used. Work is being carried out on this problem in a number of shops, especially with reference to sheet galvanizing.

The manner in which the sheet is fed into flux appears to have a distinct bearing on coating adherence. At present there is no set practice. In some shops, the sheets are placed in a bosh under water acidulated with hydrochloric acid (about a 3 per cent solution) and fed directly from this tank through squeegee rolls into the molten flux; in other shops, the sheets are fed dry into a concentrated hydrochloric acid bath and then through squeegee rolls into the flux. Straight dry feeding has also been tried, but in such cases the flux does not appear to be "active."

The principal object in all of these practices is to get the steel base into the molten zinc while the surface of the base is as nearly chemically clean as possible and with a slight surface etch. A considerable amount of progress has been made along these lines, but there is still an enormous amount of work to be done. The cleaning and fluxing are the heart of any hot galvanizing operation.

Equipment

When we consider the coating step proper, we find that it is here that most development work is being constantly carried out on

1. Furnace design
2. Temperature control
3. Handling equipment, especially for sheets
4. Processes and metallurgical control.

The tendency in furnace design has been to fire above the dross line and do this firing so that there is no direct impingement of the flame on the pot. Although this type of firing was recommended over a hundred years ago, nothing definite was done along this line until within the last few years. The latest designs which have been proposed for this type of furnace involve the use of radiant tubes or flameless combustion, although, so far as I know, neither of these processes has yet come into use for galvanizing pots. Recirculating of products of combustion has been recommended and several pots have been built with the firing based on this principle.

Automatic temperature control, together with proper furnace design, has permitted operations which can keep temperatures in the coating bath at a minimum variation. In wire galvanizing, by the use of larger pots and larger bodies of molten zinc per unit weight passing through the pot, we have been able to keep temperature variations in the bath very low. Better designs for thorough furnace insulation are also being developed and this should also aid in maintaining uniform temperatures within the pot.

In the case of sheet galvanizing, improvements have been made in the pot machine design, to permit better correlation between the speeds of entrance, guiding, and exit rolls, and controls for keeping this relation more or less constant. These developments have also included more positive tensioning means for the exit rolls, and multiple sets of guiding rolls in the pot. In one process, the pot has been designed to allow dross to be moved out of the path of the sheet at the exit rolls. This separation of the dross and its removal from the path of the sheet may prove to be a boon to the galvanizer, especially toward the end of a run. In another process the sheet has been coated, and the bath heated in a reducing atmosphere.

Speaking of appearance, a number of methods have come into use for spangle size control for sheets, or, in other words, the production of uniform spangles. This is accomplished by passing the sheet between knobbed rolls just beyond the exit rolls, together with proper temperature and speed control and bath composition, and also by means of wire-mesh exit conveyors. The latter usually involve the use of a magnetic roll to lay the sheet against the conveyor because, in the latter case, the conveyor comes in contact with one

side of the sheet only, whereas the knobbed rolls contact both sides of the sheet.

Developments have been made to permit faster cooling of sheets after galvanizing, thus allowing higher speeds to be used for coating. For example, with the old type of apparatus speeds of about 60 to 80 feet per minute for roofing stock were about the best obtainable when considering uniformity, distribution and adherence of the coating, and this figure is cut considerably, say to 50 feet per minute, when heavier coatings such as "Seal of Quality" are produced. With suitably designed modern equipment, these speeds have been considerably increased with a corresponding increase in production per galvanizing pot per unit of time.

In the writer's opinion, more progress has been made in sheet galvanizing during the past four or five years than was made since the machine type pot was developed. Progress in wire galvanizing has advanced during the last twenty years, as has galvanizing for hardware and small parts.

We are also learning more about the composition of the ferrous base to be used for galvanizing, as well as heat-treatment and other metallurgical data necessary to produce a more nearly uniform material.

We feel sure, as galvanizers, that a great deal of progress will be made during the next few years to further enlighten us along the lines of mechanical, thermal and metallurgical control. We feel that by supplementing some of the old empirical methods with the newer accurate data now being gathered, the galvanizing industry will enter a new era of development, and both producer and consumer will share the benefits of this progress.

Progress In Electrogalvanizing*

By J. A. Singmaster

President, Singmaster & Breyer

I have been asked to address the Institute on "Progress in Electrogalvanizing." I do not propose to attempt a theoretical or historical resume of the subject since the Institute has already had that information presented to them in a very thorough manner. I refer first to the paper entitled "Electrolytic Zinc Methods Applied to Galvanizing" given by U. C. Tainton at the meeting in 1937, and to the subsequent paper entitled "The Meaker Process of Electrogalvanizing" given by Ernest H. Lyons the year following. These two papers covered broadly the two methods then in commercial application, and this division is still a logical one.

The process described by Mr. Lyons is the older of the two insofar as it describes the electroplating of iron or steel articles in a zinc sulphate bath, using metallic zinc as a soluble anode and the objects to be plated as the cathode.

These metallic zinc anodes are cast in a wide variety of shapes from high grade zinc as a rule. 99.99 zinc is preferred even to zinc analyzing 99.985. The impurities in lower grades of zinc cause the accumulation of sludge, which in turn interferes with the appearance of the work, causes disturbances in the electroplating operation itself, and reduces the efficiency of the process.

The anodes of metallic zinc become coated with this sludge, which prevents the free passage of the current and brings about the accumulation of decomposed zinc in the bottom of the plating tank. In order to overcome this difficulty, which takes place even with high purity zinc anodes to some degree, the use of alloy anodes containing aluminum, mercury, or aluminum and mercury, has found an interesting application. Over the past six years, the consumption of anodes of this kind has more than tripled. The claims for the alloyed anode may be summarized as follows:

1. Insolubility of the zinc except when the current is on.
2. Marked reduction of scrap loss.
3. Maintenance of the desired pH value of the solution.
4. Metal content of the solution can always be kept at the most advantageous point.
5. The prevention of loss of zinc in the sludge.

This method of galvanizing is used for a great variety of purposes. The largest tonnage of zinc is probably used in the electrogalvanizing of wire, including wire screen cloth, strip and conduit—where the operations are continuous. There are also other applications too numerous to mention, including, however, such articles as pipe and conduit fittings, bolts, nuts, screws, automobile parts, washing machine parts, and the like.

There is another relatively new development employing the electrodeposition of zinc from metallic anodes, namely, the Coronizing treatment. This process involves a preliminary electrodeposition of nickel on the steel articles, followed by an electrogalvanizing treatment. The articles thus coated are then subjected to a heat treatment. This material has proved to have a high resistance to corrosion under the special conditions obtaining in the applications thus far made. It is a development which is certainly worth following.

The estimated consumption of metallic zinc in the shape of anodes for electrogalvanizing was 4,000 tons in 1937 and 3,000 tons for 1938. Final figures are not available for the year 1939, but are estimated to be in excess of 5,000 tons—which shows a healthy growth in this method of galvanizing.

We now come to the second method of electrogalvanizing, namely, that described by Tainton in his paper of 1937. The Bethlehem Steel Co. continues to be the sole producer in this country, as far as we are aware, of material electrogalvanized by this process. Mr. Tainton said in 1937: "In 1933, operations were commenced on a unit built at the Sparrows Point plant of the Bethlehem Steel Company. This plant has been in continous operation since that time. In 1935, a similar unit of larger capacity was built at the Johnstown plant of the Bethlehem Steel Co. The product from this unit goes largely into fencing for farm use, replacing the hot-dip wire previously used. The combined output of the two plants is of the order of ninety tons of wire per day and, owing to their inability to supply the demand, additional capacity is contemplated."

The additional capacity contemplated is reported to have been installed in 1939 and has roughly doubled the combined capacity of the units mentioned in Mr. Tainton's paper.

The commercial success of this method of galvanizing is confirmed by the items in the Bethlehem Steel Company's Annual Report to Employees for last year, from which I quote as follows:

"The following are some recent developments that are reflected in better service to users of Bethlehem Steel materials:

1. The bethanizing process, which vastly increased the utility of zinc-coated wire, has been adapted for the zinc coating of sheets. Bethanized sheets are now being made in a pilot plant."

At the risk of some repetition, I call your attention to the fact that the Tainton Process uses an insoluble anode and supplies the zinc to the bath in the form of a zinc sulphate solution, which in turn is obtained by dissolving zinc directly from roasted zinc ore. In the cell a strongly acid condition is maintained, and as zinc is deposited, additional free sulphuric acid is generated in the solution which is circulated through the bath and leaves it in condition to dissolve more zinc. After suitable purification, it is again returned to the bath for the deposit of more zinc. It is evident that this method eliminates the necessity of making spelter from the ore, and consequently has on its credit side the cost of smelting the zinc. It also has on its credit side, insofar as the actual commercial plants we know of are concerned, the advantage of using a much higher current density. Approximately 1,000 amperes per square foot of cathode surface are used in this process, against 400 to 500 amperes per square foot of cathode surface in the process using metallic zinc anodes.

On the debit side, it has the cost of purification of the solutions, which requires close supervision and some expense. Minute quantities of various impurities can interfere very seriously with the efficiency of the process. In our opinion the credits for this process so far outweigh the debits

(*Concluded on page* 405)

*Address presented at 22nd Annual Meeting, American Zinc Institute, Inc., St. Louis, Missouri, April 30, 1940.

PLATING AND FINISHING
POLISHING — BUFFING
CLEANING — PICKLING
HOT DIP FINISHES

SHOP PROBLEMS

Technical Advisor For July Issue

G. B. HOGABOOM, JR.,
Chemical Engineer,
G. B. Hogaboom Jr. & Co.,
Newark, N. J.

When sending solutions for analysis please give following information: name and address; class of work being plated; kind of solution and volume; length, width and depth of tank; temperature of solution; current density, cleaning sequence and any other pertinent facts.

Cracking and Peeling of Plated Case-Hardened Steel

Q. We are having difficulty with a heat-treated bicycle cup and case-hardened crank cone. The job appears to be fine, except when they are handled roughly they crack and peel, especially in assembly. They are cleaned with reverse current with about 45 amperes/ft²; rinsed and pickled in a 15% hydrochloric acid solution; rinsed, copper flashed and then plated for 25 minutes in a bright nickel solution. I have tried all concentrations of both hydrochloric and sulfuric acid with both direct and reverse current. I have tried heating in an oven at 350° C., both before and after plating. Variations in current density seem to be ineffective. Your advice on this matter will be appreciated.

A. Case-hardened and heat-treated steel parts are very susceptible to hydrogen embrittlement and this will contribute to the cracking of the parts and to the peeling of the coating. The hydrogen can come from the acid pickle or from the plating operation.

If the parts are badly scaled, it is a difficult problem by ordinary acid pickling to remove the scale without inducing embrittlement. The addition of an inhibitor to the acid will help to overcome hydrogen embrittlement from the pickle. The ideal thing would be to heat-treat the parts in a non-oxidizing atmosphere to prevent oxidation and thus lessen the pickling time. If an inhibitor is used in the pickle, a cleaning solution should follow to make certain that the inhibitor is removed.

It is often inadvisable, from an adherence standpoint, to cyanide copper plate parts that have been strongly acid pickled. The surface of the metal will remain sufficiently acid despite thorough rinsing so that the reaction products with the cyanide form a film that destroys adherence of the deposit. In such cases, go direct from the pickle and rinse, into the nickel solution, starting at a low current density, and continuing at as low a current density as practical so as to prevent excessive hydrogen evolution with consequent danger of embrittlement and peeling. Operating at pH 5.8 will give less danger from embrittlement than at lower pH values, and higher temperatures.

If a cyanide copper flash is considered necessary, then after pickling and rinsing go into a fairly strong (10 ozs./gal.) sodium cyanide solution. Run this warm for faster action. This will neutralize acid. Then go into cyanide copper, rinse in two rinses, then go into a dip composed of nickel plating solution made acid with sulfuric acid. This will neutralize last traces of the cyanide copper solution, then direct into plating tank.

Whatever procedure is used, examine the work carefully before going into the first plating tank, whether it is copper or nickel, to see that the surface of the metal is clear and free from smut. It is practically impossible to pickle off heavy scale without leaving a smut on the work. Removal of this is necessary to get adherence. Check for its removal, before plating, by wiping occasional pieces with a clean white cloth. If your present procedure does not remove smut, the best thing to do is hand-scrub it off until you have worked out a method to fit your case.—G.B.H., Jr.

Porosity of Pins

Q. Enclosed you will find a few samples of pins which have been plated for 1 hour. We would like to have a porosity test made on these pins and would like to know methods for detecting porosity.

A. We suggest that the porosity

be tested occasionally in the plant using either the hot water test or the ferroxyl test which are employed as follows:

Hot Water Test:

Immerse the articles in distilled water at 95° C. for 6 hours and examine for rust spots with black nuclei. The distilled water should show slightly pink to phenolphthalein indicator.

Ferroxyl Test:

	Grams per liter
Sodium chloride	100
Potassium ferricyanide	10
Agar-agar	10

The article is immersed in this mixture for about 15-20 minutes. Where the iron is exposed through the pores in the nickel plate, a blue coloration will form. The article should not be exposed to the action of this solution for much more than 20 minutes before examination since there is a slight attack on the nickel plate which will result in more pores being indicated than are actually present.

—G.B H., Jr.

Brighter Nickel Solution

Q. Will you please analyze the solution sent you and tell me how to improve the brightness.

A. The composition of your solution is as follows:

Nickel	3.70 ozs./gal.
Chloride, as ammonium chloride	2.90 "
pH	6.1

This solution is not in bad condition as far as the above constituents are concerned. The addition of 2 ozs. of sulfuric acid (fluid ozs.) to each 100 gallons of solution will bring the pH closer to 5.8 which can be tried to see if it has a favorable effect on the brightness.

It will be difficult to get a brighter nickel without bringing up a better lustre on the base cast iron.

Brighteners such as cadmium or gum type brighteners like gum arabic, can be used in the nickel solution. The cadmium brightener will produce a darker nickel. Also, the deposit will be more brittle, and would not be suitable for heavy plating, should such be desired. The effect of cadmium can be tried out in a test crock of 5 or 10 gallons. Make a stock solution of 4 ozs. of cadmium sulfate in a gallon of water, and use this in the proportion of 2 fluid ozs. to each 100 gallons of nickel solution. Maintenance can be by small additions of the stock solution, or by hanging a stick or ball of cadmium on the anode rod. If the color of the deposit is too dark, add cobalt sulfate to the solution (about 1 lb. to each 100 gallons). Control of this type of solution is difficult.

It is noted that after the cleaner you rinse and then nickel plate. It is suggested that after the cleaner and rinse, you give the work a dip in 10% hydrochloric acid, to neutralize cleaner remaining in the pores of the casting. Then rinse and nickel plate.

Brown Color on Aluminum

Q. Will you please tell me how to obtain a light brown color on an aluminum tray which has flower designs in the middle of the tray. I would like to obtain relief effects by having the oxide in the design and by relieving the highlights.

A. There is no good method of oxidizing aluminum in the way that is possible with copper.

It is believed your best procedure would be to buff and lacquer the tray. Then apply a color ground in oil, or a japan, and wipe off. Lacquer again.

The following formulae have appeared in the literature for giving a brown color on aluminum:

Potassium permanganate	5 to 10 grams
Nitric acid	2 to 4 cc.
Copper nitrate	5 grams
Water	1 liter

Potassium chlorate	5 parts
Nickel carbonate	2 "
Single nickel salts	5 "
Water	50 "

The success of such dips for your purpose could not be stated.

—G.B.H , Jr.

Iron Plating Solution

Q. We are experiencing difficulty in maintaining a ferrous chloride iron plating solution of the following formula.

$FeCl_2 \cdot 4H_2O$	40 ozs./gal.
$CaCl_2$	20 " "
Free HCl	0.074 " "
pH	1.8 (quinhydrone)
Temp.	185° F.

This formula was obtained in the 1939 issue of Plating and Finishing Guidebook. In preparing this solution a much larger amount of HCl was used to attain the proper pH. In operation the pH rose rapidly necessitating frequent additions of HCl. The iron anodes were vigorously attacked.

Copper rods were plated in this solution and a satisfactory plate deposited. Changes in pH, however, gave negative results.

How can the specified pH be attained with the amount of HCl suggested in the formula? Can oxidation from the ferrous to ferric state be retarded?

We use a commercial grade of ferrous chloride from which seems to ooze viscous tarry matter which forms an oily scum on the surface of the solution. Bare spots occasionally occur which we attribute to this cause. How may this difficulty be remedied?

A. Before operating a ferrous chloride solution it is imperative that the necessary procedure be followed to completely reduce the solution to the ferrous condition. Also while operating the bath, the ferric content must be kept very low. This will require periodic additions of hydrochloric acid, but not in quantities large enough to cause the iron anodes to be vigorously corroded. The anodes should dissolve smoothly and quite uniformly.

After operating the bath, a slight accumulation of a brownish scum will be noted on the sides of the tank at the top of the solution and will adhere to the rubber cubes which are sometimes floated on the top of it. This slight froth will not cause bare spots or unsatisfactory deposits even when the iron deposit may be lifted in and out of the solution for observation or when interruptions may be necessary as in the case of very heavy deposits.

In the 1940 Plating & Finishing Guidebook, an article by C. T. Thomas on Iron Plating is a most complete description and proven procedure on iron deposition from chloride solutions.

Considerable heat is engendered when concentrated sulphuric acid and water are mixed. Therefore, water should never be poured into concentrated sulphuric acid; the acid should be poured into water.

ELECTROPLATING DIGEST

SELECTED ABSTRACTS ON PLATING—FINISHING—RUST PROOFING—LACQUERING

Soldering Flux

U. S. Patent No. 2,172,979, *F. Koehler, E. Rouette & W. Standop, September* 12, 1939. For soft soldering aluminum and aluminum-magnesium alloys. A complex salt containing stannic halide and hydrohalide of a hydrogen rich amine base in reactive combination with at least one stannous halide and at least one zinc halide. Example: 35 parts of triethylamine chlorstannate and 65 parts of one of the following:

	I.	*II.*	*III.*	*IV.*
Tin chloride	85.5	85.5	85.5	85.5
Zinc chloride	7.5	7.5	7.5	7.5
Lead chloride	7.0	..	..	..
Cadmium chloride	..	7.0	..	..
Antimony chloride	..	..	7.0	..
Bismuth trichloride				7.0

Pickling Steel Wire

U. S. Patent No. 2,174,722, *F. A. Herrmann, October* 3, 1939. Process for continuously pickling steel wire, etc., by anodizing in sulfuric acid of a concentration below 250 grams per liter and a current density above 20 amps./dm², high enough to liberate oxygen at the anode. The anodizing is started at room temperature and as the temperature increases due to the resistance to the electrical current, the acid concentration is decreased and the current density is increased.

Acid Neutralizer

U. S. Patent No. 2,175,620, *R. R. Smith, H. E. Miller and R. H. Gelder, assignors to The American Rolling Mill Co., October* 10, 1939. For neutralizing pickling acid on steel to be subsequently coated by painting, enameling, etc., a solution of sodium cyanide instead of the usual lime neutralizer which is difficult to rinse. Solution to contain:

Cyanide ..... 0.120—0.150 oz./gal.

Temperature 140°—180°F. Immersion time = 1—40 seconds.

Galvanizing Flux

U. S. Patent No. 2,175,706, *T. C. Scott, assignor to Continental Steel Corp., October* 10, 1939. When hot galvanizing in a pot containing a layer of molten zinc over a layer of lead, spots of lead oxide form on the work. This is eliminated according to the patent by using a reducing agent after emergence from the molten metal, such as oxalic acid, preferably together with ammonium chloride. One part of oxalic acid to 4 parts of sal ammoniac is suggested, to be applied by dipping or to the emergence rolls in the case of sheets.

Brass Plating

U. S. Patent No. 2,181,773. *C. J. Wernlund,* assignor to E. I. duPont de Nemours & Co. *November* 28, 1939. Method of producing brass deposit of controlled composition from a solution containing zinc and copper cyanides and caustic soda with a controlled ratio of zinc cyanide to caustic soda of 2:3 to 2:1. Example:

For white brass:		
Sodium cyanide	60	g/l
Copper cyanide	17	"
Zinc cyanide	60	"
Caustic soda	60	"

Add ½ g/l of sodium sulfide to precipitate impurities. Electrolyze at 10-100 amps./sq. ft. and temperature of 25°-80° C. Anode is 30% copper and 70% zinc.

Cathode efficiency = 64-82%.

For yellow brass:	*A*	*B*	
Sodium cyanide	135	90	g/l
Copper cyanide	90	60	"
Zinc cyanide	12	8	"
Caustic soda	12	8	"

Anode composition = 70% copper and 30% zinc.

Bath A at 28° C. gave deposits containing about 67% copper.

Bath B at 28° C. gave deposits containing about 75% copper.

Bath B at 52° C. gave deposits containing about 87.5% copper. The composition of the deposit does not change appreciably with large variations in current density.

Process of Making Negatives in Metal Objects Substantially Smooth Surface

U. S. Patent 2,171,599. *W. C. Reid,* assignor to Metallizing Engineering Co., Inc., Sept. 5, 1939. Process comprises spraying the model with a metal, the model being at least at the temperature of incipient adhesion for the object and the applied metal, and below the temperature at which inseparable adhesion occurs, at least until the surface is covered with the applied metal.

Descaling Ferrous Metals

U. S. Patent 2,188,930. *C. A. Vincent-Daviss,* assignor to E. I. duPont de Nemours & Co., Inc., February 6, 1940. Process of removal of scale from ferrous metals by contacting them with a fused alloy of lead containing at least 0.5% by weight of sodium, at a temperature of not less than about 500°C., and then removing any adherent lead alloy by brushing and washing with water. Patent claims 0.5-10% by weight of sodium alloyed with lead and temperature of 600°-800° C. The alloy is kept out of contact with air preferably by a layer of fused salt, fused alkali metal hydroxide or other fused alkali metal compound stable at the temperature of operation, such as: caustic soda, chlorides of alkalies and alkaline earth metals, etc.

Examples of bath:

Lead	94.7%	by wt.
Sodium	5.3%	" "

Cover with layer of fused NaOH and heat to 620° C. The ferrous article is immersed for 2 minutes and cooled in air. Then brushed with steel wire brush in a stream of hot water. The resulting surface does not rust readily.

Bright Dip

U. S. Patent 2,186,579. *G. Dubpernell and K. G. Soderberg,* assignors by mesne assignments to The Udylite Corp., Detroit, Mich. January 9, 1940. Method of brightening metals electronegative to iron and belonging to the second sub-group of the second group of the periodic system of elements by immersing in chromic acid solution plus a catalyst in form of sulfate radical in the ratio of chromic acid to sulfate of below 20:1. Follow by dip in any acid of pH 2.68 or less to remove the film formed in the chromic acid. May also use nitrate and chloride as catalyst instead of sulfate, the critical ratios being 12:1 and 10:1 respectively. Chromic acid content may be from 25 g/l to saturated.

Method of Pickling Iron

U. S. Patent No. 2,171,981, *W. Heimberger, September* 5, 1939. Process of pickling iron with an aqueous solution heated above 50°C, (preferably 70°-80°C), containing free mineral acid in amount sufficiently low to permit the metal salt formed to be precipitated by hydrolysis, an oxidant and up to about 5% of a salt, the anion of which differs from that of the acid and a cation which is less noble than the metal treated,—such as: Sulfuric acid in amounts up to 1% and alkali metal nitrate in amounts up to about 5%. The free acid is allowed to drop below 0.1% and is maintained below 0.1% for the duration of the pickling treatment. The process takes a long time but the pickled surface resists oxidation. If the object is heavily rusted or scaled, this should be removed first by the usual pickle. Example of bath:

Sulfuric acid	0.25%
Potassium nitrate	2%

Post Scripts

Log of our Safari to Dayton

At 10:00 A.M. Saturday, June 8th, *Clarence C. Helmle* (G.E. Co.) roared out of Hartsdale, N. Y., with the Mrs., the *Ed. Charlesons* (Yale and Towne), *Ye Post Scripter* and the Mrs. on our safari of 730 miles to Dayton. We passed Crestwood home of Darco's *Walter Helbig* in nothing flat and then down to New York. How different the ships were from last year when we went to Asbury Park. The Normandie was still there but looked rather desolate, the Queen Elizabeth loomed up like a grey mountain but there were few of the boats of yesteryear. Most of the large boats are supposed to have plating rooms and if this is true, then there are a few boat platers out of work.

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Crossing the Pulaski highway many famous companies can be seen: American Can Co., where *George Reuter* works; Pyrene Mfg. Co., where *Louis Donroe* and *Louis Eckelmann* hang their respective hats; the huge Western Electric Co. plant which sent *W. T. Maguire* to the convention; Worthington Pump Co., and a host of other famous names. Then on by the Watchung Mountains through Flemington where the Hauptmann trial for kidnaping the Lindbergh baby took place, across the Delaware River at Lambertville and finally by Lansdale, home of *Leroy Beaver*. Valley Forge is passed and in about an hour we reached Lancaster, home of Hamilton Watch Co., where *Leroy Critchfield* presides over the destiny of the plating room.

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In Lancaster and other towns nearby, we saw many women dressed in quaint garbs of some religious sect. York, home of a General Electric Co. plant, historical Gettysburg and Chambersburg are passed and finally we set up our camp in Bedford. We found out later that *George Wagner* and *Horace Smith* had camped there the night before.

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Then out to Greensburg, Pa., home of Sulphur Products Company. It was too late in the day to call on Mac, but we learned that *Wilfred S. McKeon*, entertained the president-elect, *Frederick M. Fulforth* and *Mrs. Fulforth*, as well as *Mr.* and *Mrs. Horace Smith*, *Mr.* and *Mrs. George Wagner* and *Mr.* and *Mrs. Chris Kuell*.

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Amid heat and thunderstorms, we crossed the beautiful (?) Ohio River. Whoever wrote the song "Beautiful Ohio" must have had impaired vision as even Connecticut's Naugatuck River is a sparkling stream in comparison. Zanesville was reached and about 6:00 P.M. we had our first glimpse of Columbus, Ohio, which is a beautiful city. The next stop was Springfield where we saw *Al Hannon's* workshop, The Mitchell Engineering Co., branch of Frederic B. Stevens, Inc. Incidentally, we have a picture of Al on page 372 and he looks just like one of those tobacco auctioneers in the Lucky Strike advertisements.

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After what seemed like a long journey, Dayton was finally reached about 9:00 P.M. The Biltmore Hotel was turning them away but fortunately we had a

Charlie Conley, boss of the Dayton convention, in a relaxed moment at the Springfield Country Club.

reservation. We were very hot and somewhat dusty, and this brings up a story concerning *Colin Hastie* (Westinghouse) and *Bill Seidel* (National Blank Book Co.). Colin and Bill drove out to Dayton from Mass., and Colin wore his plating room shirt and some ripened slacks. Bill was no Beau Brummel either. They also apparently had walked through some corn fields or pastures and had some Seven Ups or the like. They were turned away from the Biltmore and went to the Van Cleve. The clerk rather haughtily gazed at the two arrivals scanning them from head to foot and announced dramatically that they (the hotel) had no rooms available for the wayfarers. This got Colin's Scotch up and Bill didn't feel so good about it either. After delivering an oration to the effect that their currency was as good as the next fellow and with a few well-directed epithets, Colin and Bill were allowed to enter the Sanctum Sanctorum.

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We exchanged greetings with *Austin Fletcher* (Brewer-Titchner Co.) and Austin's first remark was: "Gosh, Walter, can't you do something about heat at conventions". P.S. We have written an editorial in this issue giving our viewpoints. *Dave X. Clarin* (Oakite Products, Inc.) looked cool as he always does and was doing his daily good turn by helping newcomers find hotel rooms. Dave told us a good story and being a Yale man, we enjoyed it the more. It concerns a mama seagull and a maiden seagull who were flying over the Thames River, Conn. Their conversation went something like this:

Young Seagull: "Mother, what are those two boats doing down on the river?"

Mother Seagull: "Why, that's the Yale-Harvard Boat Race."

Young Seagull: "Who is going to win, mother?"

Mother Seagull: "Yale is going to win, my child."

Young Seagull: "How do you know that Yale is going to win, mother?"

Mother Seagull: "Because I put everything I had on Harvard."

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Things were rather quiet and all that could be heard was an occasional, "Who dealt this?"—"Give me four"—"A full house"—"Count me out"—"I'll up it—keep the pikers out".

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Notes taken at the Dayton Convention will be continued in the August issue.

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At the June meeting of the Bridgeport Branch of the A.E.S., *Gene Phillips* in his sick committee report stated that *George Karl* (Maas & Waldstein Co.) had ripped his hand opening a can of corned beef and an ambulance was called for treatment of the wound, which is reported to require seven stitches to close. The branch spent some time discussing what brand of corned beef George was opening—Schlitz, Ballantine or Pabst.

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I would like to take this opportunity to thank all those who kindly inquired of my father's health during those anxious days of the convention. I am deeply grieved to state that he passed away on Sunday afternoon of convention week and was buried in the town of his boyhood, Meriden, Conn.

Walter R. Meyer

Letters From Our Readers

Improved Bright Dip

Detroit, Mich.
May 28, 1940.

Dr. Walter R. Meyer, Editor
METAL FINISHING
Dear Sir:

The writer would like to advise you that he has been working a little on a bright dip which is made like the old one, which is older than the hills. However, by adding molasses, it will improve the same considerably.

It is as follows:

A bright dipping solution which works very rapidly and smoothly and which will not only bright-dip brass, copper, bronze, etc., but will also give a very smooth velvety finish as well as bright dip is:

Sulphuric acid, H_2SO_4	2 gallons
Nitric acid, HNO_3	1 gallon
Water	1 quart
New Orleans Molasses	½ pint

Also, this bright dip will work very nicely without adding any water.

Very truly yours,
Andrew V. Re.

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On Changing Our Name

May 27, 1940

Metal Industry Publishing Co.,
New York.
Gentlemen:

I was very happy this morning when I received your letter of May 23rd.

I note that you have changed the name of your good paper to METAL FINISHING. The new name is really more appropriate for a good paper such as yours. We have been using your paper for advertising purposes for quite some time. In fact, at one time we also advertised in the old Brass World, and we have found METAL FINISHING very helpful for information and advertising purposes.

The new name I am sure will be approved by everyone who is vitally interested in finishing and electroplating, and the lacquering of all sorts of metal parts. Your paper, to the reader, is not only a look appreciated for all the information a technical and practical man can get out of it, but it also brings to the reader's mind that the paper now has a most appropriate name for it.

I hold in my files practically every issue of Metal Industry and Brass World, dating way back to 1921. I treasure those copies because they are really a mine of information, an encyclopedia, and each volume supports me with assurance of knowledge in the metal finishing field.

I feel sure that in wishing you my sincere best wishes for the assured future of your Metal Finishing paper, I'm not only speaking for myself, but I believe that I also carry the wish of thousands of sincere readers in every corner of the United States, not only where metal finishing is done but also in plants where the finishing of plastics, composition and wooden articles is given into the hands of an engineer who at some time during his career has had an opportunity of being connected with a house doing some kind of metal finishing.

Our equipment is gradually finding a bigger market in the metal finishing industry and in view of the fact that we follow progressive manufacturers and always rally among those who want to be a step ahead, I certainly cannot do other than to write you the above few lines.

I again wish to state that I join and wish METAL FINISHING a wonderful future, and increased circulation.

Very truly yours,
Lupomatic Tumbling Machine Co., Inc.,
J. Lupo, Jr.,
General Manager

New York, N. Y.

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June 5, 1940

Metal Industry Publishing Co.,
New York City.
Gentlemen:

Thank you very much for your letter of May 23rd advising us that you are changing the name of Metal Industry to the new name of METAL FINISHING.

We appreciate this information and wish you all possible happiness and success in the new name as you have had with the old.

Very truly yours,
Hanson-Van Winkle-Munning Company
Louis M. Hague,
Vice-President.

Matawan, N. J.

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A Letter From "Stephie"

Dr. W. R. Meyer, Editor,
METAL FINISHING,
New York City.
Dear Dr. Meyer:

On the 12th of June, 1940, I will have finished thirty-three years of demonstrating and selling lacquers and lacquer enamels. It is over fifty years since I have entered the finishing industry, either applying or supplying finishing materials.

As I look back over the years, I wonder where many of the men are with whom I have worked and exchanged ideas, and with whom I have worked out new finishes and found new uses. I would like to know where they are and what they are doing, and would like to hear from them for old time's sake.

I know that they all read METAL FINISHING and will see this letter—so, come on, Boys, let me hear from you. I am sending greetings and good wishes to you all.

E. M. Stephenson
"Stephie"

284 Washington St.,
Hartford, Conn.

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June 3, 1940.

Metal Industry Publishing Co.,
New York.
Gentlemen:

We are in receipt of your communication of the 23rd, announcing that you had selected a new name for the old publication of Metal Industry, changing it to METAL FINISHING.

I believe the name you have adopted is more appropriate for the interest that you serve through this publication. I believe we have advertised continuously in your publication since its first issue.

We sincerely wish you continued success with this old journal with the new name.

Very truly yours,
Chas. F. L'Hommedieu & Sons Co.,
Arthur L'Hommedieu, pres.
Chicago, Ill.

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On Guidebook

June 4, 1940

Dr. W. R. Meyer, Editor,
Metal Industry Publishing Co.,
New York.
Dear Walter:

This is to acknowledge the receipt of the ninth edition of the Plating and Finishing Guidebook.

You and your collaborators have done a nice piece of work in its compilation and, therefore deserve commendation from your subscribers. I, personally, find it indispensable as it contains much "information at a glance" material.

With best wishes, I am

Very truly yours,
Paul W. C. Strausser

Frederic B. Stevens, Inc.,
Detroit, Mich.

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Well Edited and Comprehensive

"I have read with interest your splendid monthly magazine, METAL INDUSTRY, for a number of years now, and have to congratulate you on a very well edited and comprehensive organ."

Murray C. MacFarlane.

+

Educational

"In the past I have found your articles to be very interesting and educational. I trust next year's material will be the same."

C. Favetta.

(*Concluded on page* 399)

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

Pre-Coating Material for Buffs

The Lea Manufacturing Co., Waterbury, Conn., have announced the development of a new product called "Ad-Lea-Sive," for pre-coating, sewed buffs and polishing wheels.

This product is claimed to increase the adhesion of the company's greaseless compositions to the wheels. It is also suggested for set-up wheels for quick use, and in this operation, the wheel is simply pre-coated with Ad-Lea-Sive, dried and then a liberal head of the company's greaseless composition is applied, thus producing a durable and strong polishing face.

The adhesive is applied after first heating the material from 125-130° F., and at this temperature the material will become liquid. It can then be thinned with water and applied to sewed buffs or polishing wheels by means of a brush. After it has been dried to some extent, the wheel can be revolved on a spindle to complete the drying, and then the greaseless composition is applied to the wheel in the usual manner. Re-heading is possible with the new adhesive whenever necessary, thus eliminating the usual set-up operations.

Automatic Composition Applicator

The Packer Machine Co., Meriden, Conn., have announced the development of a simple, compact, self-contained applicator for automatically applying buffing composition to buffing wheels. The applicator operates independently of any external cams, projecting lugs and buffing machine speeds. It is simply plugged into a 110-volt electrical system.

The advantages claimed for the applicator are: smooth, uniform application of composition, automatically applied and controlled; a definite saving in composition costs; uses longer cakes than the regular commercial lengths thus reducing load-time.

Construction features include simple adjustments for controlling and regulating composition feed; large capacities up to 8" for various sizes of composition; smooth, rocking motion of the composition cake to the buffing wheel.

This applicator is furnished with the company's line of automatic buffing machines.

Automatic composition applicator.

New Wide Swing Grinder

Hammond Machinery Builders, Inc., 1601 Douglas Ave., Kalamazoo, Mich., have announced a new addition to their line of grinders, namely, their Rite-Speed multi-V belt driven machine as illustrated.

It is a wide swing, four bearing machine with totally enclosed fan cooled motor mounted outside of the base and with a multi-V belt drive.

Wide-swing grinder.

The grinder is said to be particularly good for bulky castings and to be efficient, due to the variable motor speeds available. It is said to be particularly desirable in 25 cycle areas as regardless of the slower speed of 25 cycle motors compared to 60 cycle, proper size sheaves can be furnished to drive wheels at the desired efficient grinding speed.

Further details can be secured from the manufacturer.

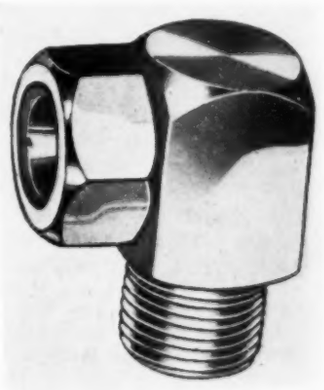
Impregnating Material for Making Fabrics Conductive

An impregnating or saturating compound for fabrics to render them electrically conductive, that hardens on exposure to light after application, has been developed and patented by Acheson Colloids Corp., Port Huron, Mich.

Containing colloidal graphite, small amounts of a hardenable organic colloid, and a hardening agent, the coating may be applied at normal or slightly elevated temperatures (to promote rapid drying).

Centrifugal Concentrated Spray Nozzle

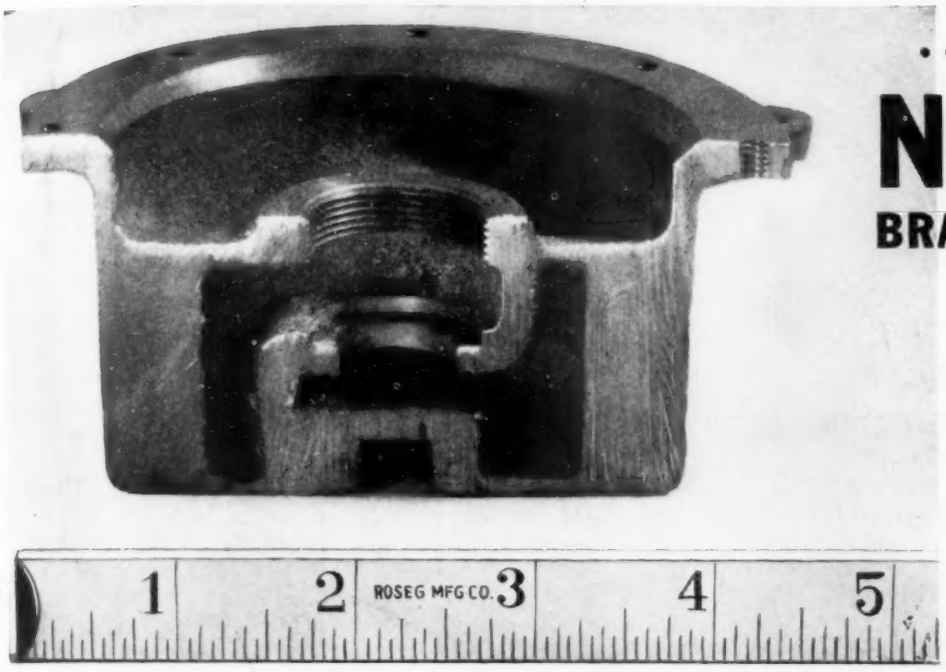
The illustration shows a non-clogging centrifugal spray nozzle with unusually large orifice, made by Spraying Systems Co., 4019-21 W. Lake St., Chicago, Ill.



Centrifugal concentrated spray nozzle.

The nozzle is of the "Whirljet" type

PRESSURE LEAKS *and* CASTING LOSSES **PLUGGED**



. . . by using

NICKEL

BRASS—BRONZE

Unusual variations in section thicknesses are mastered by adding 1½% Nickel to red brass compositions. Nickel increases fluidity, aids uniformity in thick and thin sections, minimizes porosity – thus plugging losses on rejects. This pressure-tight check valve – halved here for inspection – was cast by the National Bronze Co., Springfield, Mass., from 1½% Nickel brass.

Using an all-scrap base, the Universal Brass Mfg. Co., Los Angeles, cut foundry losses from shrinks and cracks 90% by adding 1% Nickel to sink fixture bronze. Nickel reduced porosity; and induced perfect forming of intricate patterns. Put Nickel to work for you!

To make water meter bodies stand 225 lbs. pressure, F. H. Koretke Brass and Mfg. Co., New Orleans, modifies their "G" bronze mixture with 1½% Nickel. Nickel reduces grain size, assures pressure-tight castings. Uniformity of dense-grained Nickel alloys assures easier machining, and saves on shop costs.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

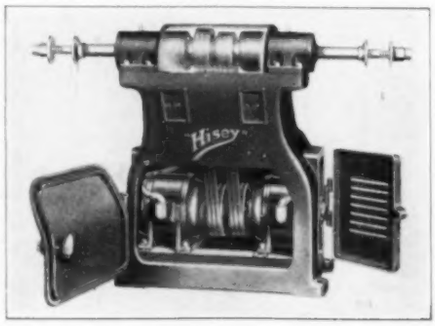
with ⅜" male pipe connection. Capacity is 2.3 gallons per minute with a 45-degree included spray angle at ten pounds pressure. Construction is said to be sturdy with smoothly rounded, large passages. Standard stock construction is 18-8 stainless steel; other materials can be specified.

The nozzle is to be used in metal cleaning processing and various industrial applications where it is necessary to have a concentrated, centrifugal, non-clogging spray that carries a long distance.

New Buffing Machine

The Hisey-Wolf Machine Co., Cincinnati, Ohio, have announced the development of their new "Tex-drive" buffers which are said to possess freedom of operation, extra heavy ball bearings, heat treated spindles, weight scientifically distributed to eliminate vibration, etc.

Illustrated is the company's two-motor, two-spindle buffer, each spindle being entirely independent. The company's line of buffing machines is described in catalog 50F, which will be sent on request.



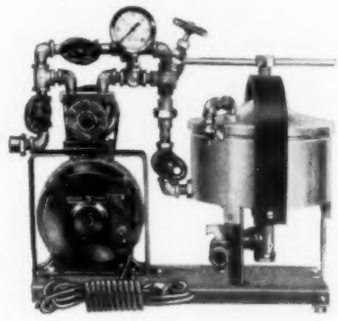
Two-motor, two-spindle buffer.

New Laboratory Filter

Development of a compact, versatile, new laboratory filter of the horizontal-plate type has just been announced by Sparkler Manufacturing Company of Chicago.

According to the manufacturer, this new filter features flexibility because it can be operated with hydrostatic pressure, air pressure, gas pressure or by vacuum. It will handle viscous materials as well as aqueous solutions in quantities from one pint up, with flow rates from one gallon to 150 gallons per hour with no unfiltered holdover and no loss of fluid.

An advantage of this new equipment, it is stated, is that every known filter medium can be used, including diatomaceous earths of all types, activated carbons, filter papers, filter or wire cloths, asbestos, fuller's earth, bleaching and absorbent clays.



Laboratory filter containing three horizontal plates 8" in diameter.

Construction consists of three horizontal plates, 8 inches in diameter, mounted in a cylindrical filter tank with single clamp cover, according to the announcement. The equipment is made in iron, aluminum, bronze, monel and stainless steel. The filtering area is one square foot with a cake space displacement of 144 cubic inches. It holds two pounds of filter aid. The unit is equipped with a ¼ H.P., 110-volt motor to drive the liquid pump that can be used for transfer purposes, if desired, it is stated.

Other features, it is pointed out, include ease of cleaning and ready accessibility of all parts.

Full details of this equipment can be obtained from Sparkler Manufacturing Company, 1210 Webster Avenue, Chicago.

New Wide Vision Goggle

A full 150° effective range of vision is offered in the new No. 220 Wide-Vision Goggle illustrated, one of the latest developments of the Chicago Eye Shield Company, Dept. M. 2362, Warren Boulevard,

Chicago. This is said by the manufacturer, to be tantamount to obtaining the widest practical amount of working vision through the medium of lens-embodying eye-protective devices. Hardened safety lenses provide maximum protection against severe impacts. Both lenses are easy to renew, by sliding them through the outer side of each eye-cup, and inserting the new replacement.

One of the important features found in the new wide-vision goggle consists of the new one-piece moulded cushion pad, which is composed of a very pliable material highly resistant to perspiration. These cushion pads are said to conform to varying contours of practically every wearer, seating each eye-cup comfortably and snugly. Additional ventilation holes in the rust-proofed metal portion of the eye-cups increases cool air circulation. The nose bridge is adjustable to varying facial widths, which accounts in part for the general utility value of the new unit.

New Hose Type Insulating Steam Joint

A new type of insulating steam joint has been developed by the Hanson-Van Winkle-Munning Co., Matawan, N. J. This joint, called the "Hose Type," consists of a special seamless rubber tube, compounded to resist steam and heat and covered with plies of strong, closely woven duck. Between these plies are placed layers of insulating rubber. A heavy gauge cover is applied on the outside.

Hose type insulating steam joint.

Each joint is 8" long and built to stand 100 pounds steam pressure. It is furnished complete with hose clamp on each end for attaching to standard size iron pipe. The joints are inexpensive, easily attached and replaced, and fully adequate for all of the normal conditions of acid and other chemical handling equipment, according to the manufacturers.

General Chemical Company Are Manufacturing Potassium Cyanide

A scarcity of potassium cyanide, due to the European War, has been relieved by the domestic manufacture of this chemical on a commercial basis by the General Chemical Company, 40 Rector Street, New York.

In the plating industry, potassium cyanide is used chiefly in gold and silver plating. The General Chemical Company is one of the largest producers of sodium cyanide and after conducting extensive experimentation for several years on the production of potassium cyanide, they have entered into the commercial production of the latter chemical. The quality is said to be equal to or better than the quality of the previously imported material. It is 94-96% KCN in strength, readily soluble in water and low in soluble material. It differs from imported material in that it consists of pure white glistening granules, all screened through 8 mesh screens.

Area Determinator

An instrument for the rapid measurement of the area of any flat object of any shape, color or texture that will fit into a circle 9.93 in. in diameter, is announced by the American Instrument Co., Silver Spring, Md.

The object may be opaque or translucent (or transparent if temporarily coated with an opaque or translucent substance). It is claimed to be especially useful for measuring the area of maps, drawings, graphs, photographs, engine indicator diagrams, printed designs on paper, fabric, etc., attached or detached plant leaves, and a host of other uses.

This new instrument, the manufacturer reports, eliminates tedious, time-consuming and less accurate planimeter measurements. It is accurate within 3% of the true area: reproducibility, within 0.2%. This accuracy is not affected, according to the company, by the experience of the operator or the nature of the object's outline. Operators can learn to measure area with this instrument in a few minutes without fatigue, eye-strain or time-consuming preparation. A measurement

can be made in 45 seconds (several hundred per 8-hr. day) regardless of the experience of the operator or the complexity of the objects' outline. The measured area is read directly from a dial. The instrument operates direct from the house current supply, and dimensions over all are 18 x 26 x 42 in. high. The housing is mounted on four wheels having pneumatic tires.

Complete details in manufacturer's bulletin MI-2081.

Manufacturers' Literature

Copper Statistics. Revere Copper and Brass, Inc., New York City, in their recently issued book entitled "Revere Weights and Data" give dimensional information on wire, circles, and sheet copper. Weights for different gauges of material are given. The company prefers that only engineers, draftsmen, estimators and designers write in for the handbook because of the expense in printing.

Die Castings. "Making the Most of Die Castings" is a reprint from an article which appeared in the January 1940 issue of Electrical Manufacturing, and which is being distributed by the N. J. Zinc Co., 160 Front St., N. Y. Helpful information on the design of castings and proper selection of material is given.

Dipping Baskets. Bulletin D104 published by the Hanson-Van Winkle-Munning Co., Matawan, N. J., describes a complete line of wire baskets in various meshes and gauges, made of steel, brass, aluminum, Monel and nickel-chromium. Steel baskets are built in specially welded construction to increase strength and length of life; no loose wires, loose ends, etc.; also glazed earthenware and sheet metal baskets.

Dust Control Equipment. Pangborn Corp., Hagerstown, Md., illustrate in a 4-page folder, various dust collecting equipment that they have installed.

Ferric Sulfate. A 12-page booklet issued by the Monsanto Chemical Co., Merrimac Div., Everett Sta., Boston, Mass., describing the use of "Ferrisul" (ferric sulfate) for pickling. Data are given for using ferric sulfate for pickling stainless steel, copper alloys and the etching of steel. Packaging information and methods of analysis are also given.

Metal Cleaning. In the June 1940 issue of Cowles Metal Cleaning Tips, issued by the Cowles Detergent Co., Cleveland, Ohio, various classes of alkaline cleaners are discussed, particularly in regard to their sodium oxide contents and effective pH in solution.

Metallizing. The Metallizing Co. of America, Inc., 1351 E. 17th St., Los Angeles, Calif., in an illustrated 16-page bulletin described the metallizing process, guns and wire used in the process. Equipment, such as sand-blasting equipment, grinders, air pressure controllers, etc. are also described.

Nickel Alloy Steels. The "Working of SAE Nickel Alloy Steels," issued by the International Nickel Co., Inc., 67 Wall St., N. Y. City, as a reprint from the article which appeared in the American Machinist magazine, October 18, 1939. Data compiled from practice of 34 leading fabricators cover effects of alloying elements, characteristics and applications, and heat treatment. Also given are practical instructions for machining, broaching, drilling, tapping, threading, milling, sawing, grinding, welding and gas cutting.

Recording Voltmeters and Ammeters. A Bulletin has just been published by the Bristol Co., Waterbury, Conn. The features incorporated to make these recorders moisture-proof and rugged enough to withstand transportation and rough use are described. The two- and three-pen instruments for recording more than one reading on the same chart are also illustrated. Copy of Bulletin No. 555 may be obtained upon request.

Temperature Control. The Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill., illustrate uses for their automatic temperature controls for plating, heat treatment, degreasing and oven baking in a 4-page folder. Various types of installations are illustrated graphically.

Water Scale Removal Compound. Oakite Products, Inc., 22 Thames St., New York, describe their material, Oakite compound No. 32, which is recommended for the removal of hard water scales which form in water circulating equipment, such as heat exchangers, spray heating apparatus, surface condensers, bottle-washing equipment, etc.

New Books

Die Castings. By Arthur Street. Distributed by Chemical Publishing Co., Inc., New York. Size 7½" x 5"; 157 pages. Price $1.75.

This is a manual for the user, buyer and designer. It is fully illustrated, with an extensive bibliography.

Contents are as follows: gravity and pressure die casting; choice of alloy; zinc-base alloy, aluminum alloy, brass and aluminum bronze die castings; designing; cored holes; undercuts, factors relating to die opening; inserts; choice of section; die casting of threads and gears; lettering and decoration; methods of assemblying; die life; cost; machining; plating of zinc base die castings; combination of plastics with die castings; inorganic and organic finishes for zinc alloy die castings; finishing of aluminum alloy die castings; inspection; should a user make his own pressure die castings.

Year Book of the American Bureau of Metal Statistics. Twentieth annual issue, 1939. Published by American Bureau of Metal Statistics, New York. Size 10" x 8"; 120 pages. Price $2.00.

A statistical compilation of data pertaining to the world's production and consumption of copper, lead, zinc, gold, silver and various other non-ferrous metals. Charts are given on the production of metals in various countries and information on smelting companies of the United States, and foreign countries.

Imports and exports are listed as well as consumption of metals by the various countries of the world. Average prices of metals since 1890 and various economic statistics are also given.

Electrocapillarity. By J. A. V. Butler. 1940. Published by Chemical Publishing Co., Inc., New York. Size 8½" x 5½"; 203 pages. Price $5.00.

The title of the book, which is exact, may not convey the full scope of the contents. The book deals with potential differences at electrified interfaces, the origin and nature of the effects that arise therefrom, and with electrode equilibria and kinetics.

The subject matter covers quite an extensive field and touches upon many branches of scientific activity, from the behavior of proteins to the passivity of metals.

Electrocapillarity is no new science and it now has important contacts with industry and biology which are likely to be extended in the future.

The topics dealt with in this book are not those of older works but the work of the last fifteen years. Most attention has been given to topics not adequately treated in other works.

Contents: the seat of the electromotive force in the galvanic cell; the thermodynamics of electrode potentials; the mechanism and energetics of reversible electrode potentials; electrical double layers; electrokinetic phenomena; electrode reactions and overvoltage; concentration polarization and the deposition of metals; some electrode processes.

Die Hartverchromung (*Hard Chromium Plating*). By Oskar Kramer. Published by Eugen G. Leuze, Verlag, Leipzig S3, Germany. Price 6.5 R.M. ($2.50). Size 8¾" x 6"; 92 pages.

This book fills a long-felt want in the plating literature. The author gives a rather complete discussion of the subject of hard chromium plating. The contents contain information on the properties of electrodeposited chromium and applications of the same, how to make the plating solution and to control it, methods of supplying current, the treatment of the objects before chromium plating, various methods of racking and supplying current to the objects to be plated, and anodes. There are also chapters on the dependency of the hardness of the deposits on the current density, and temperature, the influence of cathode efficiency with temperature and current densities, the influence of foreign ions, methods of calculating the increase in thickness of the deposit and methods for the removal of chromium plating.

Additional data are given on hardness testing, polishing, analytical methods and hints regarding thickness calculations of chromium deposits.

Unfortunately, the book is printed in German and would, therefore, only be of value to those who read this language.

Technical Papers

Silverware: Solid and Plated. Report No. 139, Second Series. U. S. Tariff Commission, Washington, D. C. For sale by the Superintendent of Documents, Washington, D. C., price 25 cents.

A survey of the various types of silverware, the organization of the industry and the trade in silverware, with special reference to factors essential to tariff consideration, are covered in this report.

Outdoor Exposure Tests of Electroplated Nickel and Chromium Coatings on Steel and Non-Ferrous Metals. By William Blum and P. W. C. Strausser. U. S. Department of Commerce, National Bureau of Standards, Washington, D. C. Research Paper RP 1293. For sale by the Superintendent of Documents, Washington, D. C., price 5 cents.

This paper includes the results and conclusions of extensive atmospheric exposure tests conducted since 1936 through cooperation of the American Electroplaters' Society, American Society for Testing Materials and the National Bureau of Standards. Exposure tests of coatings of copper, nickel or chromium, or combinations of these metals, plated upon steel, copper, brass, zinc and zinc-base die-castings were made in six locations. The thickness of the nickel layers was found to be the most important factor in the value of the coatings for protection against corrosion.

Associations and Societies

Electrochemical Society

The Fall meeting of the Society will be held in Ottawa, Canada, headquarters to be at the Hotel Chateau Laurier.

The Metropolitan Section of the Electrochemical Society have elected the following officers for the 1940-1941 season:

Dr. Walter R. Meyer, chairman
George B. Hogaboom, Jr., vice-chairman
Dr. M. E. Droz, secretary-treasurer

American Electroplaters' Society

The 1941 Annual Convention to be held in Boston, June 9-12.

Joe Barron of M. E. Baker Co., Cambridge, Mass, has been appointed general chairman, and has announced the following Committee:

National Convention Chairman: *Joe Barron,* 143 Sidney St., Cambridge, Mass.

Committee Chairmen:

Financial Secretary: *Andrew W. Garrett,* 100 King St., Dorchester, Mass.

Educational: *Arthur W. Collins,* 220 Jamaica Way, Jamaica Plain, Mass.

Exhibits: *Arthur J. Mintie,* 50 Channing St, Wollaston, Mass.

Program: *William Jones,* 8 Saco St., Dorchester, Mass.

Registration: *Charles O. Hardy,* 98 Trenton St., E. Boston, Mass.

Plant Visitations: *Louis A Gale,* 15 W. 1st St., South Boston, Mass.

Hotel Reservations: *Edward C. De Lorme,* 144 Winthrop Ave., Wollaston, Mass.

Advisory: *Frank J. Clark,* 151 Summer Ave., Springfield, Mass.

Transportation: *George H. Loeser,* 46 Wesmur Rd., Malden, Mass.

Recreation: *Walter L. Larsson,* 330 Greenwood Ave., Greenwood, R. I.

Publicity: *Louis V. Gagnon,* 286A Beacon St., Somerville, Mass.

Banquet and Entertainment: *Louis Tosi,* 80 Osborne St., Cambridge, Mass.

Ladies' Chairlady: *Miss Ann Baker,* 143 Sidney St., Cambridge, Mass.

Branch Outings

Detroit Branch—August 3rd. at Sandy Mac's. Further details later.

Lancaster Branch—August 10th.

Los Angeles Branch—July 28 at City Park, Montebello, Calif.

Los Angeles

Plans for Los Angeles Chapter's annual picnic were discussed at the June 12 meeting at Hotel Rosslyn. July 28 was agreed upon as the date most convenient to all and the scene of the picnic will again be City Park in Montebello, Calif., where last year's successful outing was held.

President *Don C. Bedwell* appointed Sergeant-at-arms *Carl C. McLaren* as chairman of the Picnic Committee. Associate committeemen chosen by Mr. McLaren were those that served in a similar capacity last year—*Earl Coffin, Clarence R. Thornton, Bruno H. Schindler* and *Harry J. Kroeschke.*

The 1939 picnic attracted an attendance of more than 100 persons. The committee contemplates a program of games and athletic contests similar to those which were so well received last year.

The educational program at the June meeting was featured by a motion picture on steel production presented by *J. B. Eberhart* of the Columbia Steel Co.'s Los Angeles office. The film showed the various processes involving in making stainless steel, annealing, galvanizing, and wire and cable making.

Clarence L. Savage, associate supervisor of the plating department of the Douglas Aircraft Co., Santa Monica, Calif., was elected to associate membership in the chapter.

No meetings will be held in July and August, in observance of the usual practice of discontinuing sessions in midsummer. The next meeting is scheduled for September 11.

Obituary

William Andrew Harshaw, chairman of the board of the Harshaw Chemical Company, Cleveland, Ohio, died June 4 at his estate in Gates Mills, after a prolonged illness. He was seventy-eight years of age.

A native of Dodgeville, Ia., Mr. Harshaw began his business career with the Meyer Bros. Drug Company, Kansas City in 1881. After being connected with various drug and chemical concerns, Mr. Harshaw entered business on his own account, forming the Cleveland Commercial Company, chemical merchants and brokers. In 1893, Ralph L. Fuller was taken into the business and in 1895 Wallace B. Goodwin became a member of the firm, which reorganized in 1898 as the Harshaw, Fuller & Goodwin Company.

Mr. Harshaw served as president of this organization from 1898 to 1924 and chairman of the board until 1929, when the company was named the Harshaw Chemical Company until 1936, when he became chairman of the directorate.

Mr. Harshaw was a trustee of the Case School of Applied Science, a member of the American Chemical Society, the Chemists' Club of New York. He also belonged to the Union Club, the Mayfield Country Club and the Chagrin Valley Hunt Club. He was prominent in the affairs of the Cleveland Chamber of Commerce and many other civic activities.

Surviving are his wife, three daughters, and two sons, one of the latter succeeding his father in the Harshaw presidency.

Letters From Our Readers

(*Concluded from page* 391)

Electroplating on Plastics

To the Editor:

I have read the interesting article by Mr. Bayard entitled, "Electroplating of Plastics" in the May issue of Metal Industry. Having had some experience in the application of the Metaplast process mentioned in the article, I would like to state a few points, which in my opinion, differ from those of the author.

1. The word "plastic" covers such a variety of chemical substances that one general formula cannot be given to cover all types of plastics.

2. The action of the alkaline solution is incorrectly described as a cleaning process, at least, for the prevailing number of cases where acetyl cellulose is most generally used. In fact, the main purpose of the alkaline treatment is to effect a change in the structure of the surface layer of the material which is certainly a physical, and most probably, also a chemical change which increases the permeability of the surface to the chemical agents used in the following stages of the process.

3. It is erroneous to call the next solution a "dilute acid". In fact, it is an aqueous solution of stannous chloride and as such, naturally gives an acid reaction. Neither is the action of the stannous chloride merely casual, nor can it be replaced by any other salt whose aqueous solution is of an acid nature. The stannous ions are highly essential as nuclei of deposition for the silver deposit.

4. In production, the applicability of the Metaplast process is annoyingly hampered by frequent difficulties which even expert engineers cannot always overcome satisfactorily.

Siegmund Frisch

Finds M. I. Informative

"My subscription to METAL INDUSTRY in the past year has been an informative one. I have found the material contained in your magazine to be very helpful and valuable. I am looking forward to receiving the 1940 issues with great anticipation."

Walter L. Born,
Chemist.

Typical Letters Asking for Information

Portable Degreaser

"We are interested in the portable degreasing unit in the Organic Finishing section, January issue of METAL INDUSTRY.

Please give us the name of the manufacturer of this equipment."

Scratch-Brush Lathe

"I purchased a plating generator from a firm advertising in METAL INDUSTRY. I made reference to this ad when I made above purchase.

Will you please furnish some information? I am interested in a scratch-brush lathe with tapered spindle. Will you kindly inform me of several companies where the above may be purchased?"

Medicament for Cyanide Sores

"Several years ago in our plating plant, we had a solution to apply to cyanide sores called 'Platers' Friend'. We have lost the address of the company from whom we obtained this medicine, and would like to know if you can supply us with this information?"

Metal Spraying Equipment

"Can you give us the name and address of manufacturers of metal spraying equipment?

We are very much interested in your article entitled 'Salvaging of Equipment by Metal Spraying', in your December issue, and would like to know where the equipment can be purchased."

Standard Analytical Solutions

"Please send me the names of firms supplying standard solutions for analysis of brass, copper, chromium, zinc, silver and nickel solutions, as described in your Plating and Finishing Guidebook."

Filters

"We are interested in procuring some filter equipment for plating room solutions.

We have written to several firms advertising in METAL INDUSTRY. Have you names of other suppliers that you can give us, who are manufacturers of this equipment?"

Metal Edges

"We are enclosing a sample of metal edge used for re-enforcing the edges of paper boxes, and are desirous of securing a source of supply of this material, similar to the sample enclosed.

We are taking this opportunity of writing you to inquire if you can advise us the firms manufacturing this type of metal edging, as we will be in the market for fairly large quantities of this material."

Brush Plating Equipment

"In your January issue on page 32, we noticed that you can furnish the names of suppliers of brush plating equipment.

We would appreciate your sending to us, a list of manufacturers, who manufacture brush plating equipment."

Automatic Tube Polishing Machine

"We beg you to quote us on a second-hand automatic tube polishing machine for finishing tubing or pipe up to 2" or more in diameter.

"If possible send illustrations or pictures of the same."

Rack Coatings

"We are using some plating racks that have to go through a degreaser, alkaline cleaner, a Rochelle copper and a bright nickel.

We are trying to find an insulation for these racks which will stand up when used in all these solutions. Will you please give us some suggestions?

A number of insulating materials that we have tried seem to go to pieces in the degreaser."

Plating and Finishing Guidebook Helpful

"Last year one of our suppliers presented me with one of your 1939 Plating and Finishing Guidebooks. I have found this book quite helpful in regard to references. Will you kindly send me a copy of your 1940 edition."

Richard E. Hall,
Mfg. Process Dept.

Worth Subscription Fee

"I think METAL INDUSTRY is one of the most outstanding books of its kind in the metal polishing and plating field. Each month there are items of valuable information to the plater, information far more valuable than the yearly subscription fee asked.

I am looking forward each month for my copy."

Clarence Armbuster.

From Abroad

"I have been engaged, since graduation in the University of Wales, as works chemist in charge of a metal finishing shop. During this period it has been my privilege to have a copy of METAL INDUSTRY regularly and to correspond with firms in the United States who advertise therein."

Wilfred L. Thorne.

Personals

At the regular meeting of the Corporation of the Polytechnic Institute of Brooklyn, on May 9th, *Dr. C. B. F. Young* was given the rank of Adjunct Professor of Chemical Engineering on the Associated Teaching Staff of the Institute.

Louis Weisberg, Inc., 71 W. 45th Street, New York, has been dissolved as of May 20th. The business will continue on the same basis as heretofore by Louis Weisberg. Except in form, there is no change in ownership or control.

Fred H. Pinkerton, sales promotion manager of the Mechanical Goods Div. of U. S. Rubber Co., New York City, was elected president of the Industrial Marketers of New Jersey, chapter of the National Industrial Advertisers Association, at the annual business meeting held in the Newark Athletic Club on May 22nd. He succeeds *Richard S. Hayes*, advertising manager, Okonite Co.

William C. Schoenfeld, a graduate of Brooklyn Polytechnic Institute with a B.S. in chemistry, has been added to the staff of Foster D. Snell, Inc., New York. *Richard Kieselbach*, a graduate of Dartmouth College with a B.S. in chemistry, has taken over accounting duties. He recently completed courses in business administration at Columbia University.

Business Items

McCallum-Hatch Bronze Co., Inc., is now located at 46 Letchworth St., Buffalo, N. Y

Col. A. L. Mercer, president and *H. L. Trembicki*, manager of the metal cleaner department of the Cowles Detergent Co., Cleveland, Ohio, announce the appointment of Mau-Sherwood Supply Co., 800 Lime Rd., Cleveland, as distributors of Cowles anhydrous metal cleaners. The Mau-Sherwood Supply Co. will maintain a complete stock of Cowles cleaners in their Cleveland warehouse and will ship to all points in Northern Ohio and Northwestern Pa. *George P. Needham*, Cowles salesman, will work closely with the Mau-Sherwood organization and will render any service necessary. Through this connection Cowles expects to perfect its distribution and service to the industry.

Koppers Co., Engineering and Construction Div., Pittsburgh, Pa., have just started construction of the plant for the Eastern Gas & Fuel Associates at Everett, Mass., and will have it ready for operation sometime this summer. The plant eventually will be able to produce 1,800 tons of ammonium thiocyanate in various grades.

The Pittsburgh office of the *Cutler-Hammer, Inc.*, has been moved to larger quarters in the Park Bldg., at 355 Fifth Ave., Pittsburgh, Pa.

The *Copper and Brass Mill Products Association*, and *Copper and Brass Research Association*, have been merged under the name of *Copper and Brass Research Association*, the address remaining 420 Lexington Ave., New York. *T. E. Veltfort* is manager, and *Bertram B. Caddle* remains secretary of the Association.

The Turner Brass Works, Sycamore, Ill., have announced the election of *John Slezak* to the presidency of the company. Since Mr. Slezak's appointment to the position of vice-president and general manager in 1931, many changes have been made. The line of blow torches and fire pots has been redesigned and enlarged, and a research and engineering laboratory has been set up. The company specializes in liquid fuel heating appliances, such as camp stoves, lanterns, metal spray guns, etc.

The camera equipment factory and color film processing plant of *Devon and McGraw* will be moved from New York City to Burbank, Calif., upon completion of a laboratory now under construction in the southern California community.

Work on a laboratory building is underway on a 2½ acre tract at Lake and

Verdugo Sts., Burbank. Grounds and studio equipment represent an investment of approximately $75,000. Size of the initial building, which will be of brick construction, will be 102 by 120 feet.

Wilfred S. McKeon, president of Sulphur Products Co., Inc., Greensburg, Pa., has announced that *J. J. Hanney,* with headquarters at 15 Putnam St., Grand Rapids, Mich., is the company's Western Michigan representative. The company produces "Liquid Sulphur", a cleaner for chromium plating, and a copper stripping material called "Copper Off".

Col. A. L. Mercer, president and *G. R. Fulton,* vice-president and general manager, *Beach Soap Co.,* Lawrence, Mass., and *Jos. W. Devorss,* president, *Consolidated Rendering Co.,* Boston, announce that the Beach Soap Co. has purchased the inventory, trade names and good-will of the *George E. Marsh Co.,* and *Lysander Kemp & Sons Corp.,* from the Consolidated Rendering Co. The Beach Soap Co. intends to continue to manufacture the present Marsh and Kemp brands of soap from the Beach plant in Lawrence, Mass. *C. F. Mudgett,* superintendent of the George E. Marsh Co., will transfer to the Beach Soap Co. The Eastern sales representatives, *Messrs. Alfred Cowan, Frank E. Allen* and *Fletcher S. Lawson,* will become a part of the field personnel of either the Beach Soap Co. or the parent *Cowles Detergent Co.*

Handy & Harman New York Offices and Plant Enlarged

Extensive additions and alterations at the New York offices and plant of Handy & Harman, 82 Fulton St., to more efficiently take care of an expanding gold and silver business, are nearing completion. Added floor space of more than 4,000 square feet has been occupied at their present location.

The company's New York plant, located at the same address, has taken over the entire first floor of the building, adding to its facilities for meeting requirements for silver and an increasing demand for karat golds and gold solders.

Improved receiving and handling arrangements will also aid in caring for shipments of sweeps, scrap, old gold and other materials which come into the New York Plant for refining.

The General Office and Sales Department have been enlarged and considerable space has been given over to the handling of new silver business in the industrial field in addition to the arts. In recent years a large number of manufacturers of refrigerators, automobiles, airplanes, electrical appliances and metal products of all kinds, have become users of silver and particularly silver brazing alloys. There has also been an increase in the use of silver for electrical contacts and for corrosion resistance in containers and equipment for the chemical and food industries.

Allen-Morrison Sign Co., Inc., Rutherford St., Lynchburg, Va., signs and displays, plans an addition to present plant, 60 x 310 ft. Cost close to $50,000 with equipment. The principal base metal used is steel.

Pennsylvania Woven Wire Co., Lock Haven, Pa., wire cloth and other wire goods, has approved plans for a one-story addition. Cost about $40,000 with equipment. The following departments are operated: plating, cleaning (alkaline), lacquering, enameling and painting. Principal base metals used are: steel, copper, bronze, zinc.

Automatic Electric Mfg. Co., 720 S. Front St., Mankato, Minn., electrical equipment and parts, has let general contract for a new one-story and basement plant at Byron and States Sts., for the production of time switches, flashers and other specialties. Cost about $45,000 with equipment. The following departments are operated: stamping, spinning, soft soldering, hard soldering, plating, grinding, polishing, buffing, barrel burnishing, tumbling, lacquering and enameling. Principal base metals used are: steel, copper, brass, bronze.

The electroplating industry was represented by a number of firms whose products were displayed in booths at the Third Annual Southern California Home Show sponsored by the Building Contractors Association of California at Pan Pacific Auditorium, Los Angeles, May 25 to June 5.

The O'Connor Electroplating Corp. of Los Angeles operated a booth displaying a fully equipped kitchen and bathroom featuring electroplated equipment in form of drawer handles, doorknobs, sink, bathroom and shower-booth fixtures.

Scull and Co., Los Angeles manufacturers of builders hardware, sponsored a booth showing samples of the firm's work in the form of brass, nickel and chromium plated door knobs, handles, rim locks and bit keys. All of Scull and Co.'s work (which is operated by John B. and Ray Scull) is done outside their factory. Considerable of their plating is done at *M. D. Rynkof's Liberty Plating Co.*, and others by the *W. K. Warle* organization.

Hallenscheid and McDonald, represented by *Don C. Bedwell*, president of Los Angeles Chapter, A.E.S., displayed a comprehensive array of plumbing hardware and bathroom fixtures. The Hallenscheid and McDonald exhibit of plated soap dishes, towel racks and bathroom fixtures was shown as a detached fixture display in a booth maintained by the *Washington-Eljer Co.* of Los Angeles, bathroom appliance manufacturers. Other firms that co-sponsored the booth were *Repcall Brass Manufacturing Co.* and *Modern Metal Arts Co.*, both of Los Angeles.

Elastic Stop Nut Corporation announces the moving of its general offices from Elizabeth, New Jersey, to its new plant at 2332 Vauxhall Road, Union, New Jersey, a suburb of Newark. The transfer of manufacturing equipment, which has been in progress for several weeks, has been completed.

The new plant will be used exclusively for the manufacture of Elastic Stop Self-locking Nuts and has been carefully planned to assure smooth flow of production. It was built by The Austin Company. A feature of interest is the fact that all of the steel construction is fastened with bolts and Elastic Stop Nuts, instead of rivets.

It is announced also that this corporation's Houston, Texas, office has been moved to The Merchants and Manufacturers Building.

Waterloo Valve Spring Compressor, Inc., 1406 E. 4th St., Waterloo, Iowa, compressors and auxiliary equipment, has let general contract for a one-story plant, 60 x 100 ft. The following departments are operated: welding, buffing, degreasing (solvent), lacquering, enameling and painting. The principal base metal used is steel.

The plant of the *Dura Steel Products Co.*, 2421 East Eighth St., Los Angeles, was destroyed by fire on February 23. Loss was estimated at approximately $100,000. An electrical short circuit that ignited some barrels of highly inflammable paint thinner was attributed as the cause.

The firm manufactures mailboxes, medicine cabinets, peanut and popcorn vending machines and other light metal articles.

New Developments in Electrogalvanizing

(*Concluded from page* 386)

that a vastly increased use of zinc dissolved directly from ore for galvanizing is indicated. The over-all recovery of zinc from the ore to the galvanized object is very high.

While this process has found no commercial application outside of the Bethlehem Steel Corporation in this country, at least two and probably more plants using the process are in operation in Europe. In England there are two plants, one of them galvanizing the wire used to hold the captive balloons employed for air defense. This service imposes very rigid specifications since the wire has to be of the maximum tensile strength. The other plant, according to our information, is galvanizing the very heavy wire or rods used in the manufacture of netting for defense against submarines.

A second process utilizing zinc ore or zinc by-products directly with insoluble anodes has been patented by Messrs. Hubbell and Weisberg. The English patent has already been issued and the American patent has been allowed.

This process uses ammonia and ammonium salts as the solvent for the zinc instead of sulphuric acid. It operates as well or indeed better in a chloride electrolyte, and accordingly makes available high chloride materials, such as sal skimmings. The plating therefore takes place in alkaline instead of acid solution. The extraction of zinc from ordinary roasted ore, Waelz oxide, and zinc by-products, generally is high.

The purification of the solution is a much simpler matter than in the Tainton process, since many of the harmful impurities do not go into solution and others, notably chlorine, which interfere with the deposition from the sulphate solution, have no effect in this process. Current densities of the same range as in Tainton's process are used with excellent results. Hundreds of small runs have been made on various sizes and kinds of wire. Upwards of one hundred tons of strip steel 10" wide have been satisfactorily galvanized by this process in a pilot plant. The galvanized strip produced has shown that the surface has remarkable adherence for paint without any pretreatment.

All of the methods under consideration are capable of producing adherent zinc coatings with good bending properties of any desired commercial thickness on wire and narrow strip.

We have no doubt that wide strip and sheet commercially electrogalvanized will be on the market in quantity in the near future.

Supply Prices, June 29, 1940

Anodes

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 2,000 lbs. or more, and subject to changes due to fluctuating metal markets.

COPPER:	Cast	21⅝c. per lb.
	Electrolytic, full size, 16⅝c.; cut to size	16⅝c. per lb.
	Rolled oval, straight, 17⅛c.; curved	18⅛c. per lb.
BRASS:	Cast	18½c. per lb.
ZINC:	Cast	11½c. per lb.

NICKEL: 90-92%, 16" and over ..... .45 per lb.
95-97%, 16" " " ..... .46 per lb.
99%+cast, 16" and over, 47c.; rolled, depolarized, 16" and over, 48c.

SILVER: Rolled silver anodes .999 fine were quoted from 38c. per Troy ounce upward, depending on quantity.

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

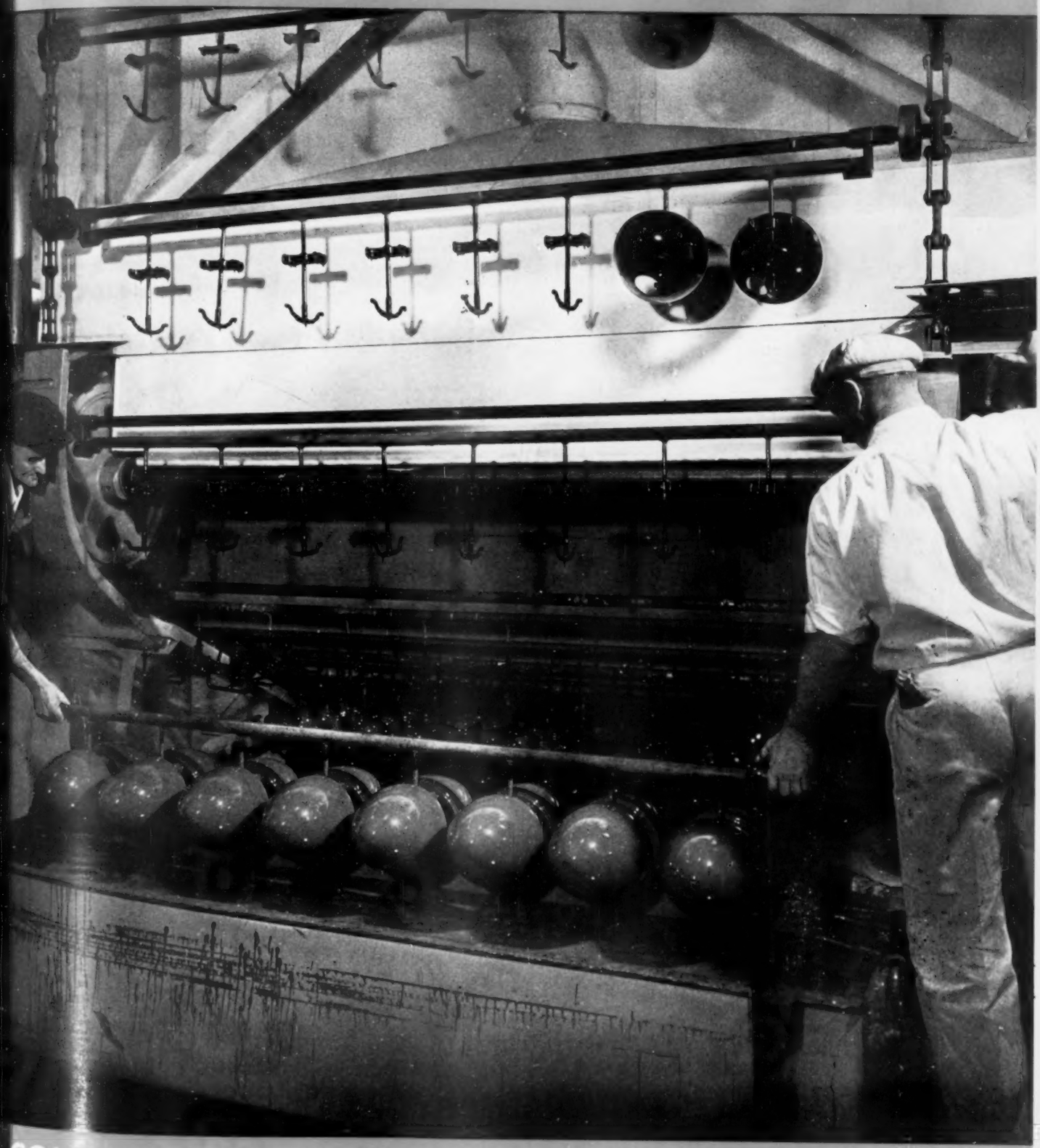
Acetone, Pure, l.c.l., drums	lb.	.08
Acid, Boric (boracic) granular, 99.5%, bbls.	lb.	.053-.059
Chromic, 99%, 100 lb. and 400 lb. drums	lb.	.16¾-.17¼
Hydrochloric (muriatic) Tech., 20°, carboys	lb.	.027
Hydrochloric, C.P., 20°, carboys	lb.	.08
Hydrofluoric, 30%, bbls.	lb.	.07-.08
Nitric, 36°, carboys	lb.	.06
Nitric, 42°, carboys	lb.	.075
Oleic (Red Oil), distilled, drums	lb.	.07¼-.08¼
Oxalic, bbls. l.c.l.	lb.	.12-.14
Stearic, double pressed, distilled, bags	lb.	.09¾-.11¼
single pressed, distilled, bags	lb.	.09¼-.10¾
triple pressed, distilled, bags	lb.	.12½-.13½
Sulphuric, 66°, carboys	lb.	.025
Alcohol, Amyl, (Fusel oil, ref'd), l.c.l., drums	lb.	.175
Butyl-normal, l.c.l., drums	lb.	.095-.105
Denat., S.D. #1, 190 pf., 1-18 drms, wks.	gal.	.335
Diacetone, pure, drums, l.c.l.	lb.	.10
Methyl, (Methanol), 95%, drums, l.c.l.	gal.	.36-.38
Propyl-Iso, 99%, l.c.l., drums	gal.	.41
Propyl-Normal, drums	gal.	.70
Alum, ammonia, granular, bbls., works	lb.	.035
Potash, granular, bbls., works	lb.	.0375
Ammonia, aqua, 26°, drums, carboys	lb.	.02½-.05¼
Ammonium, chloride (sal-ammoniac), white, granular, bbls.	lb.	.0521-.075
Sulphate, tech., bbls.	lb.	.035-.05
Sulphocyanide (thiocyanate), pure, crystal, kegs	lb.	scarce
Sulphocyanide (thiocyanate), com'l, drums	lb.	"
Antimony Chloride (butter of antimony), sol., carboys	lb.	.13
Barium Carbonate, ppted., l.c.l., bags, works	lb.	.03
Benzene (Benzol), pure, drums, works	gal.	.21
Butyl Lactate, drums	lb.	.235
Cadmium Oxide, l.c.l., bbls	lb.	.85
Calcium Carbonate (Ppted. chalk), U.S.P.	lb.	.05¾-.075
Carbon Bisulfide, l.c.l., 55 gal. drums	lb.	.05¾-.06
Carbon Tetrachloride, l.c.l., drums	gal.	.73
Chrome, green, commercial, bbls.	lb.	.21
Chromic Sulphate, drums	lb.	.26¼
Cobalt Sulphate, drums	lb.	.65
*Copper, Acetate (verdigris), bbls.	lb.	.25
Carbonate, 53/55%, bbls.	lb.	.16-.17¼
Cyanide, Tech., 100 lb. bbls.	lb.	.34
Sulphate, Tech., crystals, bbls.	lb.	.051
Cream of Tartar (potassium bitartrate), gran., bbls.	lb.	.32¾
Crocus Martis (iron oxide) red, tech., kegs	lb.	.07
Dibutyl Phthalate, l.c.l., drums	lb.	.195
Diethylene Glycol, l.c.l., drums, works	lb.	.155
Dextrine, yellow, kegs	lb.	.05-.08
Emery Flour (Turkish)	lb.	.07
Ethyl Acetate, 85%, l.c.l., drums	lb.	.075-.085
Ethylene Glycol, l.c.l., drums, works	lb.	.17-.20
Flint, powdered	ton	30.00
Fluorspar No. 1 ground, 97-98%,	ton	$60.00
Fusel Oil, refined, drums	lb.	.125-.14
*Gold, Chloride	oz.	$18¼-23
Cyanide, potassium 41%	oz.	$15.45
Cyanide, sodium 46%	oz.	$17.10
Gum, Arabic, white, powder, bbls.	lb.	.125-.14
Sandarac, prime, bags	lb.	.50
Hydrogen Peroxide, 100 volume, carboys	lb.	.20
Iron Sulphate (Copperas), bbls.	lb.	.017
Lead, Acetate (Sugar of Lead), bbls.	lb.	.11-.13¾
Oxide (Litharge), bbls.	lb.	.125
Magnesium Sulphate (Epsom Salts), tech., bag	lb.	.018
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Mercuric Oxide, red, powder, drums	lb.	$3.36
Nickel, Carbonate, dry, bbls.	lb.	.36-.41
Chloride, bbls.	lb.	.18-.22
Salts, single, 425 lb. bbls.	lb.	.135-.145
Salts, double, 425 lb. bbls.	lb.	.135-.145
Paraffin	lb.	.05-.06
Perchlorethylene, drums	lb.	.08½
Phosphorus, red, cases	lb.	.42
yellow, cases	lb.	.40
Potash, Caustic, 88-92%, flake, drums, works	lb.	.07¼-.075
Potassium, Bichromate, crystals, casks	lb.	.09¼
Carbonate (potash) 98-100%, drums	lb.	.06¾
Cyanide, 94-96%, cases	lb.	scarce
Pumice, ground, bbls.	lb.	.03
Quartz, powdered	ton	$30.00
Quicksilver (Mercury) 76 lb. flasks	flask	$200.
Rochelle Salts, crystals, bbls.	lb.	.23¼
Rosin, gum, bbls.	lb.	5.25-7.75
*Silver, Chloride, dry, 100 oz. lots	oz.	.32
Cyanide, 100 oz. lots	oz.	.33½
Nitrate, 100 oz. lots	oz.	.27
Sodium, Carbonate (soda ash), 58%, bbls.	lb.	.0235
Cyanide 96%, 100 lb. drums	lb.	.15
Hydroxide (caustic soda) 76%, flake	lb.	.0355
Hyposulphite, crystals, bbls.	lb.	.035-.065
Metasilicate, granular, bbls.	lb.	.0335
Nitrate, tech., bbls.	lb.	.029
Phosphate, tribasic, tech., bbls.	lb.	.0295
Pyrophosphate, anhydrous, bbls., l.c.l.	lb.	.0580
Sesquisilicate, drums	lb.	.0425
*Stannate, drums	lb.	.35-.38
Sulphate (Glauber's Salts), crystals, bbls., works	lb.	.0135
Sulphocyanide, drums	lb.	.30-.35
Sulphur, Flowers, bbls., works	lb.	.037-.0410
*Tin Chloride, 100 lb. kegs	lb.	.40½
Toluene (Toluol), pure, drums, works	gal.	.30-.32
Trichlorethylene, drums	lb.	.08½
Tripoli, powdered	lb.	.03
Wax, Bees, white, bleached, slabs 500 lbs.	lb.	.36-.40
Bees, yellow, crude	lb.	.24-.28½
Carnauba, refined, bags	lb.	.58-.71
Montan, bags	lb.	.25-.30
Spermaceti, blocks	lb.	.24-.27
Whiting, Bolted	lb.	.025-.06
Xylene (Xylol), drums, works	gal.	.31-.32
Zinc, carbonate, bbls.	lb.	.14-.17
Cyanide, 100 lb. kegs	lb.	.33
Chloride, granular, drums	lb.	.06
Sulphate, crystals, bbls.	lb.	.04

*Subject to fluctuations in metal prices.

JULY, 1940

ORGANIC FINISHING

SECTION OF METAL FINISHING



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S-412 bakes on a fast schedule. It is highly recommended for lamp reflectors, stoves, water heaters and other items where more than normal heat is encountered. In addition to its heat resistant values, S-412 shares the Duranite family characteristics of excellent adhesion, speed in application, toughness and durability.

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ORGANIC FINISHING

SECTION OF METAL FINISHING

JULY, 1940

CONTENTS

ARTICLES

DEPARTMENTS

Training Spray Operators

To secure skilled spray operators has always been a difficult problem. The supply has never met the demand, and, we believe, for good reason. It is simply that a farsighted policy of continuously training apprentices, such as is done in other fields, has not generally been practiced in the finishing industry. There has been too much dependence on chance to supply sprayers—too much dependence on those few who, occasionally by choice but more often through mere circumstance, have learned the technique of spraying by trial and error over a period of years.

Wherever spray finishing is done, an apprentice-sprayer program can be made to pay large dividends on a small investment of time and money. Over and above the fact that more sprayers become available is the speed and quality of spray finishing which can be obtained from an operator who, having been given correct and regular instruction, is free from the errors he would have if he merely picked up his knowledge. Such a training course need not be long and involved. Finishing today has become less an art and more a skill, thanks to modern finishing materials and equipment, and it is entirely possible to produce good spray operators in a relatively short time.

L. J. LANGDON, *Publisher* • THOMAS A. TRUMBOUR, *Business Manager* • DR. WALTER R. MEYER, *Editor*

New Conception of Petroleum Solvents and Thinners

By Edward M. Toby, Jr.

American Mineral Spirits Company

2. A study of drying time in relation to the distillation curve of thinners and a study of solvent escape from films of different natures.

3. The establishment of a suitable specification for corrosion that will allow the varnish-maker sufficient protection and one that at the same time will not penalize the thinner-manufacturer to the extent of removing sulphur that in no way is harmful.

4. The perfection of an "odorless" or near-odorless thinner for use in conjunction with some of the newer finishes, such as those for food wrappers, etc., and for interior application.

Let us now consider each of these points in turn.

Solvency Evaluation

The question of arriving at a proper method of stipulating the solvency of a thinner has been under debate for years, and this complex subject has been approached from all angles. Some investigators have thought it best to go back to the fundamental chemical constitution of the thinners and express the solvency thereof in terms of the percentage of aromaticty. Considerable painstaking work has been done by your Philadelphia [4]club and some interesting data have been published by them. In my opinion this method is most applicable to high-solvency naphthas and represents to the buyer an accurate conception of just what he is buying. In the lower-solvency brackets I believe that this method does not give an exact representation of the solvency characteristics of the thinners, as there is apparently considerable variation between the various members of the paraffinic and naphthenic hydrocarbon groups insofar as their behavior with the various resins is concerned.

[4] E. H. McArdle, H. D. Terrell, J. C. Moore, E. C. Haines:—"Composition of High-Solvency Hydrocarbon Thinners." 1939.

This is the concluding portion of the article, the first part of which was published in the June issue of the Organic Finishing section of Metal Finishing.

This particular methods of test requires the use of a refractometer, which is far from common equipment in most paint and varnish plants. Kurtz, Lipkin, and Harvey presented an important contribution to this debate in their [5]work on the resin solvency of mineral spirits, in which they give as a formula:—

$$\text{Resin solveny} = \frac{\text{Kin. Vis. of Sol of x\% Resin in Std. Spts.}}{\text{Kin. Vis. of Sol of x\% Resin in Spts. under test}} \times 100$$

This method of test takes into consideration the fact that any method for determining solvency is meaningless unless some specific resin is employed in the test and reported in conjunction therewith.

These same authors also are responsible for a [6]graphic method for the determination of this resin solvency from the boiling-point density and the refractive index.

The old, familiar kauri-butanol test has fallen more and more into the discard, and even the popular ramifications thereof designed to give more accurate and reproducible results, are not the desired answer because they still give an answer in terms of the kauri-butanol value, and this result had no definite relation to the behavior of other resins dissolved in the thinner under test. The anilin cloud point is still used by some in the industry, but this test does not give results consistent with the actual cutting powers of thinners. The linseed oil reduction ratio is now in the discard and seldom encountered, its inapplicability and nonreproducibility being well known. The nitrocellulose reduction ratio is of definite importance to the lacquer formulator, but its use is confined to that field alone.

[5] S. S. Kurtz, W. T. Harvey, M. R. Lipkin:—"The Solvency of Petroleum Thinners." 1939.

[6] S. S. Kurtz, W. T. Harvey, M. R. Lipkin:—"The Graphic Determination of Resin Solvency from Boiling Point Density and Refractive Index." 1939.

The answer to the proper solvency is not yet in sight, but it is under investigation by intelligent technicians in both of our industries. We are now more familiar with your requirements from a solvency standpoint, and as a consequence the petroleum industry is cooperating much more closely with you than heretofore.

Drying Time Tests

There is no universally agreed upon method for the running of an evaporation rate test, but several methods are in wide use that give approximate results. In my opinion most accurate methods give results in terms of evaporation against a standard material and not against time. This subject is being given study and standardization should come in a few years.

However, little study is being given to the subject of solvent escape from varnish and lacquer films, insofar as petroleum thinners are concerned. In many cases you will find two petroleum solvents, where, for example, the evaporation rate of thinner "A" is faster throughout the entire curve than thinner "B" and yet "B" will evaporate from a varnish film considerably faster than "A." I feel that a complete study of this subject would prove of value to all concerned.

The subject of the establishment of a suitable corrosion test has been

given little consideration, and I feel that our industry, as a whole, has suffered thereby. The majority of petroleum thinners pass the so-called "full corrosion" test today, this test being conducted by placing the usual copper strip in the distillation flask, leaving it there throughout the distillation. A slight "peacock" is not generally accepted as reason for rejection, but a black discoloration, or an incrustation of any color, is indication that the material is unfit. This test is at best a nontechnical one, and it is questionable to me whether high-boiling materials not passing this test, might not still be perfectly safe for varnish use. By the same token the A.S.T.M. test for corrosion is not rigid enough, and material passing this test might cause trouble when reducing varnish at high temperatures, due to the formation of deleterious metallic sulphides.

The total sulphur content of a thinner, which can be determined very simply, will not suffice, as many sulphur compounds are not corrosive. In petroleum there are many sulphur compounds that are corrosive, or conductive to corrosiveness in addition to elementary sulphur itself, these being principally the mercaptans, hydrogen sulphide, alkyl sulphates, sulphonic acids, and the alkyl disulphides. Other such compounds, such as carbon bisulphide, sulphoxides, sulphones, and thiophenes, are only slightly corrosive, if at all. Naturally, the degree of corrosiveness increases greatly with increasing temperatures.[7]

Practically everyone specifies that a petroleum thinner be "doctor sweet." This test which shows the presence of mercaptan sulphur and hydrogen sulphide works a hardship on our industry inasmuch as it is sensitive beyond the realms of practicability. Material containing more than approximately 0.0004 percent mercaptan sulphur will not pass this test. The quantity required to give a positive doctor test varies from 0.00002 percent for butyl mercaptan to 0.0006 percent for ethyl and phenyl mercaptans.[8] If the material in question passes the corrosion test and has a good odor I would suggest the doctor test be waived.

To manufacture good corrosion and "doctor sweet" thinners the refiner generally must segregate his crudes, refining only those crudes that possess these qualities. While there are treating methods to lower the total sulphur content and to doctor sweeten sour distillates, these methods often tend to introduce more harmful materials than are being removed or converted. The trend in refining today is to use those methods that remove all sulphur compounds, rather than converting them as was accomplished by the use of the doctor or sodium plumbite treatment.

Odorless Thinners

The manufacturing of deodorized or even semi-deodorized thinners is in its infancy. Fairly good deodorized thinners have been commercially prepared in the higher boiling ranges, namely from approximately 350°/400° F. to 500° F., but these materials have been principally used in the insecticide trade. Unfortunately the removal of the malodorous compounds is generally accompanied by the removal of the aromatic hydrocarbons, resulting in a material of extremely low solvency characteristics. These malodorous materials are principally sulphur compounds and the olefins and diolefins.

These materials can be best removed by a heavy treatment with concentrated, or fuming, sulphuric acid, followed by a clay or earth treatment and subsequent redistilling. In such a treatment there is the possibility of sulphonation taking place. Many such-treated materials are unstable, some taking on an offensive odor on standing and some taking on gum-forming characteristics. We have all attempted to prepare completely deodorized naphthas by the addition of additives, but to the best of my knowledge, not one has succeeded. Of course, a nice masking odor can be secured, but not a deodorized material. I doubt if it is possible to manufacture such a product—even in extreme states of purity all petroleum products have some odor, and this odor is promulgated into the atmosphere in relation to the vapor pressure of the material. Therefore, it will be correspondingly easier to partly deodorize heavy materials than lighter ones.

You are naturally interested in the development of a deodorized naphtha, particularly for the use in interior finishes. If a closet or room is painted, then closed for a period and then examined, it will be apparent in many cases that the petroleum thinner has more than just an obnoxious odor. This is due to improper or insufficient treatment of the thinner in question. The after or residual odor of the thinner can be determined in the laboratory by noting the odor of the residue of the thinner after distillation or, better still, by immersing a piece of cheesecloth in the thinner, permitting it to half dry, then sealing in a mason jar and examining after forty-eight hours.

I do not think that a deodorized, or even a good semi-deodorized thinner will be commercially available for some time to come, but I think that you can secure a thinner that is satisfactory in this respect by insisting on a fully and properly treated thinner. I am certain that you will have to waive some degree of deodorization to secure material of above the average solvency. However, there are some mineral spirits available in the 45-48 kauri-butanol range whose odor is still in the well-treated mineral spirits category. This is because these spirits derive their solvency from their naphthenic content, these naphthenes being most resistant to removal when treating for odor, and being non-malodorous in their own right.

It is not the scope of this paper to go into detail on those petroleum thinners commercially available today. However, I will mention briefly some of the high points of the thinners introduced recently.

Coaltar Replacements

Much interest has been shown recently in the benzol and toluol replacements used for nitrocellulose coatings. The most common benzol replacement boils between 140° and 210° F.; while the most common toluol replacements boils between 200° and 265° F. New in this field is a product boiling between 175° and 230° F., this product showing much greater blush resistance than the lighter material, while being only slightly slower in drying. Also new in this field are hexane and heptane, boiling at 140° to 155° F. and 185° to 210° F., respectively. Hexane is very fast in drying and contains less than 0.0016 percent evaporation residue by weight. This is principally normal hexane, and it has found a definite place in the arti-

[7] V. A. Kalichevsky, B. A. Stagner:—"The Chemical Refining of Petroleum." 1933.

[8] L. M. Henderson, M. S. Agruss, George W. Ayers, jr.:—"Effect of Sulphur and Sulphur Compounds in Naphtha Upon Certain Corrosion Test" (Industrial and Engineering Chemistry, January 15, 1940).

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WRINKLE FINISHES GO MODERN

Wrinkle finishes have always enjoyed great favor because they can be applied directly to rough metal surfaces. Until recently, however, they could be obtained only in dark colors.

Now, M&W supplies a complete line of Duart Wrinkle Enamels in almost all colors, including white, brilliant light shades, soft pastels, transparent colors, and clear, thus greatly increasing the number of products on which these beautiful, economical finishes can be used. Especially attractive effects can be secured by applying a coat of Metalustre over a base coat of Duart Wrinkle Enamel.

METALUSTRE STILL A LEADER

Metalustre, which gives a lustrous durable metallic finish in a single air-drying coat, became one of the most popular finishes in the metal working and novelty field almost over night, when introduced a few years ago, and still retains its leadership.

Its economy adapts it for finishing inexpensive products, but its beauty is such that it is also used on better grades of household and office equipment. For a more durable metallic finish Codur Baking Metalustre Enamels are used.

MAKE ZINC LOOK LIKE BRASS

Platelustre is a brilliant, semi-transparent finish which is designed for use on polished metals, such as zinc or aluminum, to make them resemble brass, copper, bronze, anodic or chemically treated aluminum and steel, and other colored metals. It also can be used to produce entirely new colorings.

As Platelustre greatly extends the usefulness of the cheaper "white" metals, it is being used by manufacturers of compacts, clocks, lighting fixtures, novelties, casket hardware, and other products where a brilliant colored metallic finish is desired.

This finish is supplied for either air drying or baking. Baking Platelustre is very durable and will resist the action of cleaning operations and also nickel, chromium, and other plating baths. When applied sectionally, a wide variety of effects can be secured. Two color finishes can be obtained by "relieving" operations.

Baking Platelustre can be applied to flat stock by roller coating and will withstand forming and machining.

A HIGH-SPEED GRAINING SCHEDULE

For base coat, use A.D. Durad Speed Primer, which dries out of dust in 5 minutes and is ready to receive the graining ink in 1 hour. Apply grain. Baking can be eliminated if clear M&W lacquer is used for the top coat. For a more durable finish, use clear Codur Baking Lacquer for the top coat, and bake 30 minutes at 275 degrees F.

INFORMATION ON REQUEST

Full information on any of the products will be sent on request. Or, if you desire, an M&W Finishing Engineer, who is thoroughly experienced in all phases of industrial finishing, will call and assist you in solving your finishing problems.

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Advertisement

ficial leather field. Heptane is being used to some degree in regular lacquers, its high blush resistance and fast drying time being of great advantage.

The toluol replacement is available in high solvency fractions, varying from 45 percent to 70 percent in aromaticity. There are no such benzol replacements available in great quantity, inasmuch as they would have to depend on their solvency from benzol itself and the product would have the same inherent disadvantages as benzol itself from a toxic standpoint. The economic standpoint, based upon the low cost of benzol itself, does not offer much of an incentive to manufacture such a product.

The war abroad has presented the lacquer industry with a problem because of the continued shortage of toluol. In the face of continuance of this conflict, or in a national emergency here, it is very probable that the present high-solvency naphthas might find their way into the manufacture of explosives. Thus toluol will then have to be partly replaced by a low-solvency petroleum diluent. Therefore, if the price of toluol exceeds all reasonable limits, or toluol is unavailable at any cost, we can expect an increased demand for the 200°-265° F. replacements.

V.M.P. Replacements

The old types of V.M. & P. naphthas have been largely replaced by the narrow-boiling fractions designed for this purpose. A cut boiling between 235° and 295° F. is believed best for this purpose. The high initial boiling point induces a greater margin of safety, better flow, better brushability, better leveling; while the lower endpoint gives tackfree drying in much less time than the old V.M. & P. naphthas which boiled between 180° and 375° F.

The lack of a material boiling between mineral spirits and V.M. & P. naphtha has always been felt. One material to fill this need has recently been put on the market, boiling between 280° and 345° F.; this material approached the safe flashpoint of mineral spirits while having substantially the fast drying time of V.M. & P. naphtha.

The high initial insures a flashpoint above [illegible] F. thus making it possible to ship the thinner, or any product in which it is the sole thinner, without a red label necessary on inflammable goods. The endpoint being lower than that of old-style V.M. & P. naphtha, insures a total evaporation time faster than that obtained with many V.M. & P. naphthas without the hazard which usually accompanies V.M. & P. naphthas.

Protective coats in which it is used have good leveling qualities due to the high initial boiling point and yet the total drying time is extremely short due to the low endpoint. Finishes so thinned can be classed as quick drying. Manufacturers using this solvent in wall coatings produce finishes that permit the application of second coats the same day.

Its use in the industrial coating field is being investigated thoroughly by several manufacturers. No doubt it will shortly find its proper place as a thinner in numerous industrial products; to date it has been found suitable for use in wall coatings, four-hour enamels, and dipping enamels and varnishes.

The most important development relative to mineral spirits itself is the development of 45-48 kauri-butanol materials of good corrosion and good odor, and available at reasonable prices. These materials are available at only a minimum premium over regular mineral spirits. The advantages of such mineral spirits, where greater resin-cutting power is desired, are obvious. We have also developed, for shipment into certain areas, a 70 kauri-butanol mineral spirits at a price level intermediate between that of regular mineral spirits and those higher solvency products in the 90 percent aromaticity range.

High-Boiling Materials

New materials boiling above mineral spirits are becoming more and more utilized in your industry. These products boil between 370° and 460° F.; and, unlike kerosene, which boils between approximately 325° and 530° F., are fully treated, passing corrosion and odor tests.

In this cut we have an ideal thinner for flat wall liquids and paints. Heretofore in an effort to delay the initial set of flat wall finishes, kerosene in varying proportions has been added. The resulting volatile finish has been a blend of mineral spirits and kerosene. Certain apparent advantages were gained by the use of this kerosene as were some disadvantages as well.

Apparently the initial set was delayed and certainly the drying time was extended. This in part approached the ideal condition insofar as initial set was concerned, but the drying time was extended beyond all practical necessity. Paints produced in this manner were apt to develop "dead spots" on drying, due to the nonvolatile "tails" present in the kerosene. After-yellowing and soft films can also be attributed to the presence of kerosene.

To overcome this trouble and at the same time fulfill the desires of the flat-paint manufacturers, the new thinners were introduced. Here we have a thinner with an initial boiling point not only higher than the initial of the blend of kerosene and mineral spirits (which would be about 320° F.), but also higher than kerosene itself (325° to 530° F.). Thus, with its initial boiling point of 370° F., this product removed any possibility of laps showing due to the quick setting of the vehicle. On the other hand, the low endpoint of 460° F., which is 60 degrees or more below the endpoint of kerosene, insures that the thinner is 100 percent volatile, thus the possibility of "dead spots" appearing in a dry film is eliminated entirely.

No desirable quality of the kerosene-mineral spirits blend has been sacrificed. Insofar as solvency is concerned with a kauri-butanol of 32-33, the No. 460 naphtha has a solvency virtually the same as obtained in the blend, which would be approximately 33. Its use, therefore, would not upset present formulas due to extreme differences of viscosity in the liquid upon addition of the required amount of thinner.

The use of such materials in flat wall liquids has steadily increased.

Even higher boiling than these fractions are others boiling between 360° and 510° F. These products are also treated to pass corrosion and odor tests and have a place in certain formulations where the high endpoint is desirable.

Taking everything into consideration, I feel that the petroleum industry has kept abreast of your industry insofar as our common frontier is concerned, and I assure you that we will be capable of meeting the new demands that you may place upon us.

FINIS

High Temperature Lacquering

By D. J. Stedtefeld

Chief Chemist
Clinton Co., Chicago

The technique for applying hot lacquers in an effort to spray heavier coatings of lacquers and to reduce solvent costs, has been developed. Lacquers with solids from 28 to 40% can now be sprayed using the hot technique, which requires special equipment. The advantages and specially designed equipment required are discussed by the author.—Ed.

Ever since the introduction of lacquer into the finishing field, there has been an effort afoot to perfect a material having a combination of the desirable features of both varnish and lacquer; in short, a material having, as C. W. Simms said recently, "the drying speed, hardness and print resistance of lacquer together with the full body and flow of varnish." The principal thought prompting research along this line was to find a means of increasing the solids content of lacquers and lowering finishing costs. One of the fruits of this study and research by the lacquer chemist has been the development of "hot lacquer," a term commonly applied to high-temperature lacquer used in conjunction with specially designed spraying equipment.

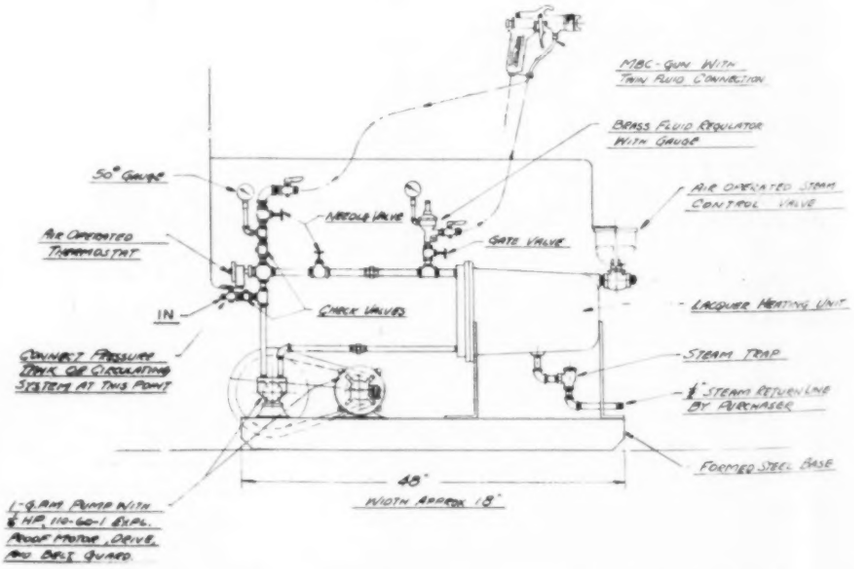
Essentially, the process involves a novel system of lacquer formulation and application which depends upon the effect of heat rather than upon the addition of thinner to reduce the lacquer to a suitable spraying viscosity. The purpose of applying heat to lacquer is to bring about a reduction of viscosity to a point where relatively high concentration of solids can be applied to surfaces to be finished. "The idea," says Henry H. Nelson, in an article entitled "High-Temperature Application of Nitrocellulose Lacquers," in the January, 1939, issue of Industrial and Engineering Chemistry, ". . . is soundly conceived. It is based on the sound principle that the viscosity of nitrocellulose solutions is sharply reduced at somewhat elevated temperatures. . . . By the application of heat to reduce the viscosity of lacquers, it is now possible to spray from 28 to 40 per cent solids. This can be done, still retaining the working properties that make the use of nitrocellulose lacquers desirable."

Advantages

Among the advantages that have accrued from the development of this new system of spraying lacquers at elevated temperatures may be listed: A substantial reduction in finishing costs, due to the increased solids content of lacquers applied at higher temperatures with the consequent reduction in the number of coats, which in turn reduces the finishing time. There is also less loss of lacquer in the form of spray dust. Not to be ignored is the fact that there is also a saving in the cost of volatiles, since the high temperature lacquers contain a higher ratio of non-volatiles to volatiles (higher solids content), a lesser volume of volatiles being required to apply any desired thickness of film. Furthermore, there is the production of lacquer films that are comparable in build-up to films of synthetic enamels, yet retaining the special advantages of lacquer, such as rapid drying and hardening, easy sanding and patching, and a brilliance and clarity of color.

The formulation of lacquer for hot application differs measureably from the formulation of those to be applied cold. Lacquer prepared for application at room temperature will not produce satisfactory results when applied at high temperatures. Experience has demonstrated the need of eliminating most or all of the low-boiling solvents in the formula and replacing them with higher-boiling solvents, as well as replacing low-boiling diluents with higher-boiling ones, giving the lacquer better flow-characteristics and eliminating the danger of dry-spray or dusting, and at the same time avoiding the rapid cooling of lacquer in the spray cone. Lacquer chemists have been working along this line and have produced what they are convinced are products that will meet the need. Charles Bogin, an industrial chemist, has been granted a patent covering the process of applying hot lacquers.

The rapid cooling of the material



Drawing of steam type lacquer heating unit mounted on 48" x 18" steel base.

in the spray cone is due to its contact with atmospheric temperature and the cooling effect of the evaporating solvents. Simms calls attention to tests having been made with the use of heated air in an effort to prolong the cooling period. The results, however, were not satisfactory since the air cooled to room temperature almost immediately upon leaving the gun orifice. Because of this drop in temperature in the spray cone, together with the resulting increase in viscosity as the material reaches the object being finished, it is extremely important that correctly balanced solvents be used in the formulation of lacquer for high temperatures.

The spraying equipment used in the application of high temperature lacquer is similar to other paint spraying equipment with the exception that a heating element is used for raising the temperature of the lacquer. The heat may be applied by a thermostatically controlled steam or hot water bath through which passes a copper coil of sufficient size and length to keep the lacquer at a constant temperature and at a flow consistent with the rate of consumption. Any cooling of the material in the hose is prevented by a circulating system keeping the quantity necessary for spraying at the desired spraying temperature, constantly moving past the spray gun. In short, every trigger pull taps this stream of heated material at the desired rate of flow and correct pressure.

There are, of course, various types of units designed for use in the spraying of high temperature lacquer, since the wide range in viscosity makes it difficult for one type of unit to serve a universal purpose. One of the units being used is mounted on a base some 48 in. x 18 in., which can be attached directly to a standard pressure feed tank or circulating system already in use. This unit recirculates the lacquer within itself while the pressure feed tank or circulating system merely replaces the material discharged by the spray gun. Any pressure up to 35 lbs. may be maintained by a circulating pump mounted on the base. Hot water or steam is used for heating the lacquer, the unit being designed to work on steam pressure not exceeding 5 lbs. If steam at a higher pressure is to be used, a steam pressure reduc-

A portable electric heater and pumping unit for handling medium to small production lines.

(*Continued on page 417*)

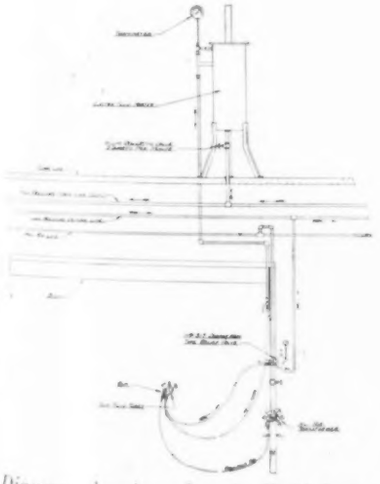


Diagram showing electric fluid heater installed on floor directly above spray booth.

New Developments In Wrinkle Finishes Revealed At Technical Production Conference

Attending the Technical Production Conference held by New Wrinkle, Inc., in Dayton, Ohio, May 17 and 18 in the interest of its manufacturing licensees were more than 100 engineers and chemists. One or more representatives from the following firms attended the Conference: Advance Paint Company, Allied Finishing Specialties, Arco Company, Atlas Powder Company (Zapon Div.), Ault & Wiborg Corporation, Barrett Varnish Company, R. A. Becker Varnish Company, Berry Brothers, Inc., Buckeye Paint & Varnish Company, A. Burdsal Company, Chicago Bronze & Color Works, Cincinnati Varnish Company, Clinton Company, Cook Paint & Varnish Company, DeSoto Paint & Varnish Company, F. J. Donahue Varnish Company, Columbus Varnish Company, Egyptian Lacquer Mfg. Co., Felton-Sibley Co., Inc., Ferbert-Schorndorfer Co., Flood & Conklin Co., Forbes Varnish Co., The Glidden Company, J. E. Harris Company, Illinois Paint Works, Impervious Varnish Company, Indianapolis Paint & Color Co., Jones Dabney Company, Kay & Ess Company, Lilly Varnish Company, Chas. R. Long, Jr. Company, Lowe Bros. Company, Marietta Paint & Color Co., Maas & Waldstein Co., Patterson Sargent Company, Pittsburgh Plate Glass Co., Rinshed-Mason Company, Rockford Varnish Company, Roxalin Flexible Lacquer Company, Schaefer Varnish Company, Sherwin-Williams, Speed-O-Laq Products Company, Standard Varnish Works, Stanley Chemical Company, Sullivan Varnish Co., Thresher Varnish Company, Tousey Varnish Company, Universal Paint & Varnish Co., Varnish Products Company.

The morning and afternoon sessions were held in New Wrinkle's recently completed laboratory building located in the heart of Dayton and only a few blocks from its main offices in the Mutual Home Building, while the evening meetings and demonstrations took place at the Dayton Engineers Club. On display at the laboratory were numerous samples and photographs of wrinkle finished articles to show the widespread use and application of wrinkle on all types of surfaces, including flexible materials, such as textile goods, fabrics, book covers, paper and leather.

The Technical Production Conference was held to acquaint wrinkle paint manufacturers with the problems arising from the increasing demand for wrinkle finishes. Brought to the attention of its licensees were all new developments, particularly the formulation of both varnish and alkyd types of wrinkles on which New Wrinkle chemists have been working for the past year. These new formulations were shown and demonstrated in the laboratory in the presence of every one.

In addition to New Wrinkle's latest disclosures on matters of manufacturing and formulation, considerable attention was given to infra-red ray drying.

After an early registration Friday morning, May 17, the conference settled down to a discussion of basic materials and methods of manufacture which was led by William A. Waldie, Technical Director of New Wrinkle, Inc.

Following the noon adjournment, the meeting was resumed and was devoted to proper application and the correct technique used in spraying wrinkle finishes. Several of the latest developments in spray equipment were shown and their outstanding features explained and demonstrated. The subject of finishing room control as applied to wrinkle materials and spray equipment was discussed. L. W. Lammiman of the De Vilbiss Company, placed considerable stress on the necessity of proper regulation of both atomizing air and fluid pressures to assist in controlling the texture of the finish desired.

It was further brought out that while the responsibility of a high grade wrinkle finish ends with the shipment, the paint maker is interested in its proper application and that in many cases the method of application has an important bearing on the formulation.

This spraying demonstration was immediately followed by a factory inspection trip to the National Cash Register Company where finishing with wrinkle was seen on a production basis. Here the attending licensees' representatives had a first-hand opportunity to study the relative merits of infra-red lamp drying and oven baking.

The evening session opened with a dinner at the Engineers Club and was followed by further discussions and demonstration in the auditorium. The advantages and applicability of wrinkle paint baking with near infra-red was presented to the meeting by Howard Haynes, Nela Park Engineering Department, General Electric Company, Cleveland, Ohio.

At this point L. W. Lammiman again addressed the conference with a short talk regarding proper spray gun air cap and fluid nozzle combinations required to handle various types of wrinkle materials.

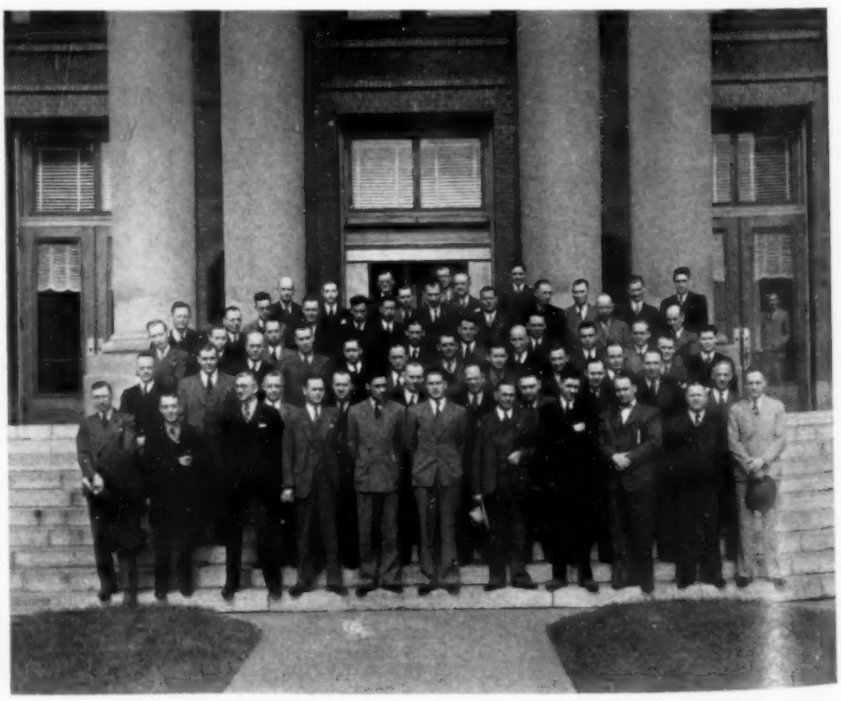
Next on the program was Mr. Hendricks of the Dayton Manufacturing Company who told the group that for the last two years his company has applied their experience in specialized lighting toward developing reflecting equipment for directing infra-red energy for baking wrinkle and other painted surfaces. It was pointed out that with this equipment baking time has been reduced as much as 90% in some instances as compared with the convection type oven.

The drying equipment demonstrated featured a deep bowl gold plated reflector which is designed to project an even spread of interesting rays. Because of its depth this reflector directs all lateral rays onto the work keeping "spill" rays at a minimum. Energy from this type of reflector is controlled in such a manner that a sufficient quantity is directed onto the leading and following surfaces of an object passing on a conveyor.

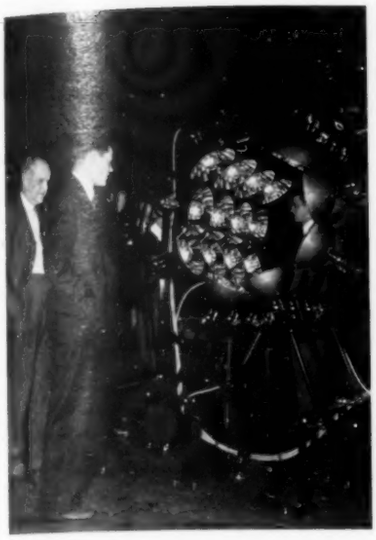
Mr. Hendricks closed by extending the uses of their laboratory to paint manufacturers for development work and to industrials interested in an infra-red installation.

Next on the evening's program at the Dayton Engineers Club were representatives of the Fostoria Pressed Steel Corporation, manufacturers of "Para-Sphere" reflector equipment for the infra-red process, who presented one of their standard flexible tunnel sections for inspection by the conferees.

It was stated by Fostoria that "the approach to the application of radiant energy



Attendants at the Technical Production Conference on wrinkle finishes.



Conferees watching a demonstration on drying wrinkle finishes by infra-red lamps.

baking of wrinkles on metals, woods and fabrics concerns the paint manufacturer along with the company building infra-red equipment. Through mutual cooperation both organizations can answer the problems of industry."

Fostoria representatives included R. F. Craig, Mid-West Division Manager, J. W. Kilmer, Chief Engineer, R. N. Green, Manager of Sales Research. Prior to inspection of equipment, Mr. Green invited paint manufacturers to use Fostoria's Service Laboratory. A brief resume of some existing infra-red installations was recounted to indicate the scope of various applications, especially in the paint industry.

An ensuing infra-red drying demonstration brought out that in some cases while various wrinkles react differently to such heat treatment, this one-coat finish is specially suitable to fast drying by the infra-red method. Sample panels were run through typical infra-red tunnels which started to wrinkle in three minutes and thoroughly drying at the end of an eight-minute cycle, as compared to a gas hour cycle of 90 minutes.

Opening the Saturday morning session, C. W. Blacketer, Diamond Alkali Company, discussed "Multifex," a new form of calcium carbonate, so fine in particle size that it may be dispersed to a colloid, and the desirable effects that are produced when well dispersed "Multifex" is used in wrinkle enamels. Though "Multifex" is a dry powder which is to be handled in the paint industry by methods and equipment customarily used for pigment incorporation, it was emphasized that "Multifex" is not a pigment. It is not used because of color, for opacity or as a filler, the usual functions of pigments. Its value is based on its ability to induce behavior in wet paints and conditions in dry films not related to color, opacity of "fill."

Of more than unusual importance was the announcement by New Wrinkle, Inc. of its new process of manufacturing a highly satisfactory and improved wrinkle without the use of China wood oil. This announcement created special interest due to the fact that, as is well known, wood oil has advanced from 12c to 28c a pound. Up until this time China wood oil was considered essential due to its wrinkling qualities in the manufacture of these finishes.

This development has been the result of six months' work in the interest of wrinkle consumers in order to assure the supply of high grade wrinkle finishes at reasonable prices. The base used in these demonstrations was "Dehydrol," the new castor oil product being produced by the Sherwin-Williams Company in a new plant especially built for this purpose.

Interest was further stimulated by the announcement of "Wrintex," a new resin. While there are innumerable resins on the market, New Wrinkle, Inc. has been devoting a considerable part of its laboratory effort toward the formulation of a new resin possessing unusual wrinkling characteristics which will facilitate more certain the manufacture of wrinkle finishes and which will offer the licensee manufacturer a product especially compounded for his purposes and one that should be of great value in assuring uniformity of result in successive batches.

Among its characteristics as a wrinkling vehicle, "Wrintex" offers economies due to its high viscosity, freedom from gas-checking, positive uniform wrinkling even on thin coats and an ability to produce a highly satisfactory wrinkle texture even after an overnight air-drying period.

"Wrintex" is to be made available to all of its licensees by New Wrinkle, Inc.

Saturday afternoon the laboratory facilities were thrown open for use of those present and various new varnishes were actually cooked, several of its new formulae produced and were discussed in an informal open meeting.

New Wrinkle licensee firms were represented at the Technical Production Conference by more than 100 chemists and research engineers. Among those present were: Arthur H. Cramer, R. S. Harrington, L. T. Jordon, O. L. Kinder, Dr. S. M. Kolar, A. G. Sternberg, George Schaider, R. W. Gordon, W. L. Hensley, C. J. Borger, G. Shriner, R. A. Swain, B. Husted, G. A. Nichols, M. S. Paxton, J. M. Hafeli, J. J. Hendricks, P. F. Whalen, Jr., W. L. DeBruler, D. V. Smith, W. E. Mueller, E. O. Lacy, D. J. Stedtefeld, A. E. Stackhouse, N. Ellis, P. Wendt, C. M. Weston, C. Krieg, J. Bryan, F. E. Chapman, A. H. Stover, H. M. Wilcox, C. A. Holkesvig, C. Young, J. S. Murphy, H. E. Miles, F. W. Frew, V. J. Galvani, E. H. Fay, Jr., M. H. Smith, A. R. Smith, R. W. Evans, K. M. Copeland, L. W. Laird, H. A. Chloupek, H. M. Fowler, A. W. Graef, L. F. Hatfield, S. Lower, R. G. Smith, J. M. Purdy, B. J. Hegman, E. R. Ewell, E. Gibson, J. S. Congleton, C. H. Leopold, B. T. Harlan, A. F. Rylander, J. T. Cherry, P. Kretschmer, C. L. Rydstrom, F. Lindell, W. H. Stephens, H. F. Donahew, F. G. Nessler, E. E. Swenarton, C. H. Williams, J. W. Johnston, F. W. Porter, B Larson, E. P. Stark, P. Evans, W. A. Martin, L. J. Keeler, E. M. Hayden, W. S. Ryan, M. Sullivan, J. E. Heller, S. G. Titcombe, L. Puterbaugh, H. C. Snodgrass, O. Campbell, S. D. Fields, J. H. Grady.

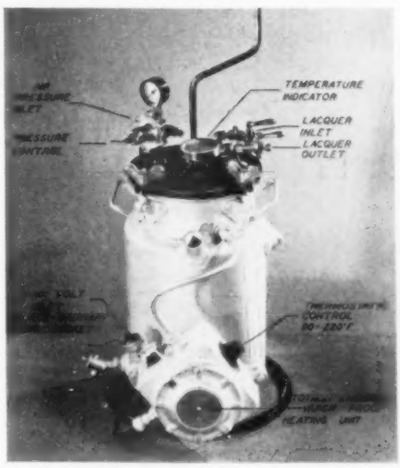
Due to the enthusiasm displayed by the attending licensee representatives it is probable that New Wrinkle, Inc. will make these technical sessions at Dayton an annual affair. In addition, it is contemplated that New Wrinkle, Inc. will put on a similar demonstration next fall in the interest of users of wrinkle finish.

High Temperature Lacquering

(*Concluded from page* 415)

ing valve may be installed.

Some units are electrically heated, the heat being applied to water or a non-carbonizing oil, which in turn heats the coils through which the lacquer passes on its way to the spray gun. Another type of electrically-operated heater consists of a pressure kettle enclosed in an electrically-heated water jacket, which serves to bring the lacquer up to the desired temperature prior to its application by the spray gun. These electrically-operated units are all thermostatically controlled.



Electrically-operated heater for hot-spray lacquer, consisting of a pressure kettle within an electrically-heated water jacket.

Like in any other field of endeavor, research and experimentation are being continued by the lacquer chemists and by the manufacturers of equipment. It may be that the time will come when equipment and lacquer will be perfected so that higher solids lacquers can be sprayed without being heated.

EDITOR'S NOTE:

For helpful suggestions and the courteous loan of pictures we are grateful to:

Commercial Solvents Corporation, New York, N. Y.

The De Vilbiss Company, Toledo, Ohio
The Glidden Company, Cleveland, Ohio
Pierce & Stevens, Inc., Buffalo, N. Y.
The Sharples Solvent Corporation, Philadelphia, Pa.

Solvents and Industry

Normal Butyl Acetate

(Butanol acetate, n-butyl acetate)

Physical Properties

Normal butyl acetate, the normal butyl ester of acetic acid, is a neutral, colorless and flammable organic liquid possessing a pleasantly mild fruity odor which is less pronounced than that of amyl acetate. It has the chemical formula $CH_3COOCH_2CH_2CH_2CH_3$ and a molecular weight of 116.16. In the pure form it is listed as having a specific gravity of 0.882 at 20°/4°C. (approximately 7.35 pounds per gallon, about 12 per cent lighter than water). Its boiling point at 760 mm. mercury pressure is 126°C. and its melting point is −76.8°C. At 20°C. its vapor pressure is 10 mm. of mercury. The closed cup flash point is 78°F.

Normal butyl acetate is miscible in all proportions with most of the common organic solvents. It is a solvent for nitrocellulose, ethyl cellulose and cellulose acetopropionate; for gums such as dewaxed dammar, ester, kauri, manila and pontianak; for synthetic resins such as vinyl, polystyrene, methacrylate and chlorinated rubber; and for a wide variety of mineral and vegetable oils, waxes and other materials, including camphor, pitch, linseed oil, castor oil, etc. Shellac, copal ester and metallic resinates only partially dissolve in normal butyl acetate. It is a non-solvent for cellulose acetate and hard copal and softens but does not dissolve gum rubber.

Pure normal butyl acetate dissolves in water to a maximum of 1.0 per cent by weight at 20°C. Water is soluble in it only up to 1.4 per cent by weight at 20°C. A constant boiling mixture of water and normal butyl acetate, containing 72 per cent by weight of the latter, boils at 90.5°C.

Referred to normal butyl alcohol as having a value of 100, normal butyl acetate has an evaporation rate of about 208, that is, slightly more than twice that of normal butyl alcohol. It is slower in evaporating than acetone and ethyl acetate and faster than diacetone alcohol.

Manufacture

Acetates are made by the esterification of alcohols with acetic acid, hydrochloric or sulphuric acid being used as a catalyst. Normal butyl acetate is usually produced by the batch method in a still equipped with a fractionating column and condensers. A mixture of high quality normal butyl alcohol, approximately 75 per cent acetic acid and sulphuric acid catalyst is charged into the still and refluxed until a high yield of normal butyl acetate is obtained. The water is removed and the normal butyl acetate and normal butyl alcohol are returned to the still, the latter mixture being finally separated by fractionation.

Normal butyl acetate may also be obtained from a process starting with acetylene. Acetaldehyde, prepared from acetylene, is condensed to form crotonic aldehyde. The crotonic aldehyde is then reduced with metals and acetic acid to form normal butyl acetate.

Uses

Normal butyl acetate has become the most important and widely used medium boiling solvent for nitrocellulose, replacing amyl acetate by virtue of its lower cost, purity, favorable evaporation rate and other properties. Just as ethyl acetate is generally accepted as being the standard low boiling nitrocellulose solvent, so normal butyl acetate has become the standard medium boiling solvent.

Since normal butyl acetate produces solutions of nitrocellulose of relatively low viscosity, possesses a mild and non-residual odor, has a high tolerance for diluents, imparts excellent flow characteristics and diminishes blushing tendencies, especially in conjunction with butyl alcohol (which enhances its solvent power for nitrocellulose), it is employed in large quantities in the production of lacquers and lacquer thinners, fingernail enamels, leather and paper coatings, airplane dopes and similar coating materials. It is also used as an ingredient or a processing material in the manufacture of photographic film, plastic wood, linoleum, celluloid and plastic products and safety glass.

In small quantities, normal butyl acetate is used as an odorant in dry cleaning fluids, paint removers, detergents and spirit varnishes. It is useful as an extracting agent and either alone or in combination with butyl alcohol, with which it forms a constant boiling mixture, as a dehydrating agent. It is also employed as a component of flavoring extracts, perfumes and fruit essences.

Physiological Properties

In irritative and narcotic action, according to Browning, normal butyl acetate is apparently similar to amyl acetate, both producing slight irritation of the eyes, nose and throat, a sensation of pressure in the chest, cough and exhaustion. However, at least one investigator considers normal butyl acetate to be in the group of the least toxic of organic solvents and such evidence as is shown on respiratory and conjunctival irritation, headache, gastro-intestinal disturbance, etc., does not appear to be conclusive.

Standard Specifications for Normal Butyl Acetate (88 to 92 Per Cent Grade)

A.S.T.M. Designation: D 303 - 33

Issued As Tentative, 1929; Adopted In Amended Form, 1933

Properties

1. Normal butyl acetate (88 to 92 per cent grade) shall conform to the following requirements:

Specific gravity, 20°/20°C.	0.872 to 0.878
Color	water white
Distillation range:[a]	
Below 110°C.	none
Below 120°C.	not more than 15 per cent
Above 127°C.	not more than 30 per cent
Above 145°C.	none
Non-volatile matter	not more than 0.005 g. per 100 ml.
Odor	mild, non-residual
Water	miscible without turbidity in all proportions with 60° Baume gasoline at 20°C.
Acidity (free acid as acetic acid)	not more than 0.03 per cent, equivalent to 0.28 mg. KOH per gram of sample.
Ester value	88—92 per cent by weight

Methods of Testing

2. The sampling and methods of testing shall be conducted in accordance with the Standard Methods of Sampling and Testing Lacquer Solvents and Diluents (A.S.T.M. Designation: D 268) of the American Society for Testing Materials.

(a) The thermometer used for the distillation test shall conform to the general requirements of the Standard Specifications for A.S.T.M. Partial-Immersion Thermometer for General Use, −20 to +150°C., 0 to +300°F. (A.S.T.M. Designation: D 1[illegible]) of the American Society for Testing Materials.

ORGANIC FINISHING DIGEST

PATENT AND LITERATURE REVIEWS

DRYING OILS AND RESINS. T. F. Bradley and W. B. Johnston, Industrial & Eng. Chem. Vol. 32, 802 (1940). A theoretical discussion and study of the chemical structure of drying oils and resins.

DRYING WITH INFRA-RED RADIATION. H. A. Clark. American Gas Journal. Vol. 152, p. 43-5, May (1940). A comprehensive comparison of drying operations with gas ovens and with the more recent near-infra red radiations, produced by electric lamps mounted in gold plated reflectors.

ETHYL CELLULOSE. W. Koch. Can. Chem. & Process Ind. Vol. 24, p. 200, April (1940). A resume of the properties, constitution and uses of ethyl cellulose; its use in lacquers, etc.

CHEMICAL EXAMINATION OF UREA COATING RESINS. J. J. Levenson, Jr., Ind. & Eng. Chem. Anal. Ed. p. 332-337, June (1940). A discussion and description of chemical methods for examining various resins formed by the condensation of formaldehyde, alcohols and urea, that are used in modern lacquers.

THE USE OF LACTATES AS SOLVENTS. E. S. Greigov. Peintures, pigments, vernes. 16, 141-3 (1939). There are several paraffin lactates that are coming in for more and more consideration as lacquer solvents. The ethyl, butyl and amyl esters of lactic acid have excellent solvent power for nitrocellulose, cellulose acetate and various varnish resins which are useful in formulating lacquers, which may contain drying oils.

STABILIZING BLACK LACQUERS. Max R. Vogel. U. S. Patent 2,190,461. Feb. 13, (1940). A method for stabilizing black lacquers consisting of nitrocellulose, a dissolved copper soap and a colloidally dispersed carbon black which involves incorporating into the lacquer mix prior to the inception of flocculation, a polyamine selected from the class consisting of benzylamine, m-phenylenediamine, etc.

STABILITY OF LACQUER FILMS TOWARD CHEMICAL ACTION IN THE WATER PHASE. D. P. Kraft. Khim Referat. Zhur. 6,104 (1939). A number of tests and investigations were made by the writer on the stability of a number of lacquers (bitumens, oil, glyphthalic, chlorvinyl, etc.) toward the action of various acids and alkalies. The tests were conducted by placing lacquer films on iron sheets and exposing these sheets to the various reagents in water solution.

PROPERTIES AND USES AND APPLICATIONS OF NOVELTY LACQUERS. F. Zimmer. Farben Ztg. 44, 875-6 (1939). A short resume of the technicalities of lacquers that produce novelty effects, such as crackle, fish scale, crystal, imitation metal. Possible uses are pointed out.

NITROCELLULOSE LACQUERS FOR SPECIAL PURPOSES. A. Kraus. Nitrocellulose, 11, 23-4 (1940). A general discussion of nitrocellulose lacquers and a description of their uses for special purposes.

LATEST DEVELOPMENTS IN NITROCELLULOSE LACQUERS. A. Kraus. Chem. Ztg. 64, 23-4 (1940). A review of the latest developments in nitrocellulose lacquers.

DRYING (OF LACQUERED ARTICLES WITH NEAR INFRA-RED RADIATION). General Electric Review. 42, 145-49 (1939). A description and discussion of the latest method for drying lacquers and enamels by the use of infra-red radiation produced by 250 watt bulbs mounted in gold plated reflectors which transmit most of the heat radiation. A number of transmission curves and diagrams are given.

GLYPTAL OIL LACQUERS. A. A. Blagonravova and V. M. Kobetskaya, Org. Chem. Ind. (U.S.S.R.) 6, 386-9 (1939). Linseed oil is heated with glycerol in the presence of a catalyst such as lead and cadmium oxide at a temperature of about 240° C. for 25 to 30 hours. The alcoholic solution of this reaction is condensed with phthalic anhydride at 230-240° C. in an atmosphere of carbon dioxide.

THE PERMEABILITY OF PAINT FILMS TO MOISTURE. E. Ya. Gol-denshtein and M. K. Khimulina. Byull Molyarnoi Tekh. 1-2, 30-3 (1939). A study of the moisture permeability of various types of lacquers and paints. The writer investigated the relation between the permeability of films of various types of paints to moisture and the thickness of the whole film as well as that of single layers from which it was formed. Zinc oxide, zinc chromate and ferric oxide were used as pigments. The moisture permeability was found to be inversely proportional to the number of layers in cases of their equal thicknesses. This was found to be true in cases of coverings from 1-6 layer films with thickness of the single layer from 40-80 microns. The water permeability of the paint covering formed from 80 micron layers was higher than that of coverings of the same thickness but consisting of 2 layers each of 40 microns in thickness. The permeability of the paint films did not change during the first week of experimentation.

NATURAL AND SYNTHETIC OILS IN PROTECTIVE COATINGS. W. T. Walton, Oil and Soap. 17, 84-7 (1940). A comprehensive discussion of the use of oils such as linseed oil, perilla oil, tung oil, oiticica oil, fish oil and other oils used for paints and varnishes. Each of these oils has a field of use, some are better than others in some respects, some poorer, particularly in the manufacture of alkyd resins. These alkyd resins may be thought of as combining an oil and a resin in the same molecule. Castor oil can be converted into a drying oil by dehydrating the fatty acid, in which case its properties approach those of tung oil. Varnishes prepared from castor oil dry rapidly and such films are resistant to hot and cold water as well as to alkalies but the films are softer than those made of tung oil proper. While it is not a direct substitute for tung oil, the latter can be replaced with less change in basic formula than is necessary with other substitutes.

PROPER THICKNESS OF NITROPAINT FILMS ON AUTOMOBILE PARTS. F. I. Klibanova. Khim. Referat. Zhur. #6, 107-8 (1939). The thickness of the paint and lacquer films was investigated as against mechanical properties. With an increase of the thickness of the nitropaints, the physicomechanical properties of the films were lowered. Films with a minimum number of layers are more stable to sharp changes of temperature (ranging from 66°—minus 60° C.). Investigation of the abrasive resisting properties of the films showed that abrasion does not exceed 10 microns. A paint film of about 60-70 microns was found to give optimum results.

RESULTS OF EXPOSURE TESTS OF NEW PAINTING MATERIALS. N. N. Erofeeva. Khim. Referat. Zhur. #6, 104 (1939). A large number of substitutes for linseed oil in paints and lacquers have been developed. The writer investigated their stability to atmospheric changes. Experiments showed that the existing methods for treating castor oil do not produce paints which are sufficiently weather-resistant. Positive results were obtained in the testing of glyphthalic enamels which are superior in their weather-resisting properties to enamels prepared with castor oil and also with linseed oil.

NEW EQUIPMENT AND SUPPLIES

LATEST COMMERCIAL DEVELOPMENTS IN ORGANIC FINISHING

Rust Proofer

The American Chemical Paint Co., Ambler, Pa., in their Bulletin No. 7-8, described their A C P rust-proofer.

This rust-proofer is recommended for treating steel previous to painting. After the metal has been prepared, the compound is applied by brushing or with a spray gun in as heavy a coating as will hold to a vertical surface. The chemical is allowed to air dry on the steel for from four to twelve hours, and then the light-colored coating, which has formed on the metal, must be thoroughly rinsed with clean water. The rinsed coating is then allowed to air dry and when completely dry, is ready to receive the first coat of paint.

One gallon of rust-proofer material is said to treat from 200 to 500 sq. ft. of cleaned metal.

Shellac Fortifier

The Kindt-Collins Co., 12697 Elmwood Ave., Cleveland, Ohio, have announced the development of their shellac fortifier, which is said to have several definite advantages.

The fortifier, which is added to the shellac solution is reported to increase the abrasion resistance to more than four times that of the same shellac without the fortifier. It is claimed also that the shellac fortifier mixture will dry harder in less than half the time, permitting clearer and easier sanding. It is also said to eliminate sand-sticking.

Tests have indicated a marked reduction in permeability to moisture, claiming to make the shellac particularly valuable for moisture-proofing wood.

The shellac fortifier is available in black, green, aluminum, chrome yellow and vermilion colors as well as clear.

New Extension Spray Gun

The Eclipse Air Brush Company, 300 Park Avenue, Newark, New Jersey, has just put on the market an improved extension spray gun known as the Type EX.

This gun is for painting large surfaces beyond the natural reach of the operator without the use of scaffolding and staging. The operator stands on the floor, and as the extension gun is supplied in lengths up to 12 ft., he can paint the average wall and ceiling without having to climb.

The extension gun is also useful for painting large surfaces such as railroad cars and ship hulls.

Surfaces below the level of the operator can also be safely handled with extension gun equipment.

The Type EX extension has a detachable gun grip control, and different lengths of shaft can be used in the same grip. The shaft turns in the grip so that spray can be in any direction. The spray head is supplied in either of the two standard Eclipse models to insure the proper application of all types of materials.

Extension spray gun.

Infra-Red Finishes Announced

A newly developed line of finishes designed especially for use with infra-red baking equipment is announced this month by Ault & Wiborg Corporation. Ault & Wiborg's low-bake finish, Polymerin-100, which is included in this line, has been used extensively for some time with infra-red systems, where it is reported to cure rapidly, providing a hard, flexible and durable film.

Aware of the growing interest in and importance of infra-red baking, the company's engineers have made comprehensive studies on infra-red and infra-red finishing problems. Formulations they have developed include both undercoats—primers and primer surfacers—and topcoats in a full range of plain colors with no limitation as to lustre. A hammered effect and wrinkle finishes are also available. These finishes enable manufacturers to benefit by the time- and space-saving advantages of infra-red applications and yet maintain satisfactory characteristics of hardness, flexibility, durability, and adhesion.

Infra-red ray lamp bank for baking synthetics.

Speed schedules made possible with Polymerin have, in some cases, been reduced even further by utilizing infra-red baking equipment. A storage file, for example, which will ordinarily bake for fifteen minutes at 300° F. with Polymerin is being baked in an infra-red lamp setup in five minutes. The speed-up made possible by specially designed A & W finishes used in a large auto plant resulted in a 30% saving in light costs. Polymerin infra-red finishes are being used successfully in a variety of industries, it is reported, on household appliances, auto parts, cabinets, enclosures, and many other types of products.

The use of infra-red for industrial baking started several years ago, but until recently, infra-red has not been widely utilized because of a general lack of knowledge of its use. Today its application in finishing is spreading rapidly, thanks to a growing understanding of the efficient utilization of infra-red baking principles. Where it is being successfully used, it has, say its proponents, speeded up baking, thus lowering costs. Other advantages claimed for infra-red baking are lower capital investment in ovens, increased flexibility in use, and large savings in floor space because of the increased speed of drying operations.

It is important for manufacturers considering installing infra-red equipment in their

plants to investigate thoroughly the various aspects of this baking method. Ault & Wiborg is prepared to offer the services of infra-red finishing specialists, who will consult with manufacturers considering the use of infra-red equipment.

Hints on Handling Finishing Materials

By E. M. Stephenson

Cleaning Brushes

Tack a piece of small mesh wire onto a wooden frame and then tack a piece of cardboard or heavy paper onto the back. After the brushes have been washed in the cleaning fluid, brush them back and forth through the wire mesh. This procedure will facilitate removal of all loose bristles and loose pigment, thus obviating poor finishing, due to grit and solid particles of paint remaining on the bristles.

* * *

Care should be taken that finishing materials are used up in the same sequence as their arrival to avoid having portions of the material remain unused for long periods of time. A good way to insure proper consecutive use is to place all newcoming stocks of material behind the old stocks so that no mix-up can occur and the oldest stocks are used up first.

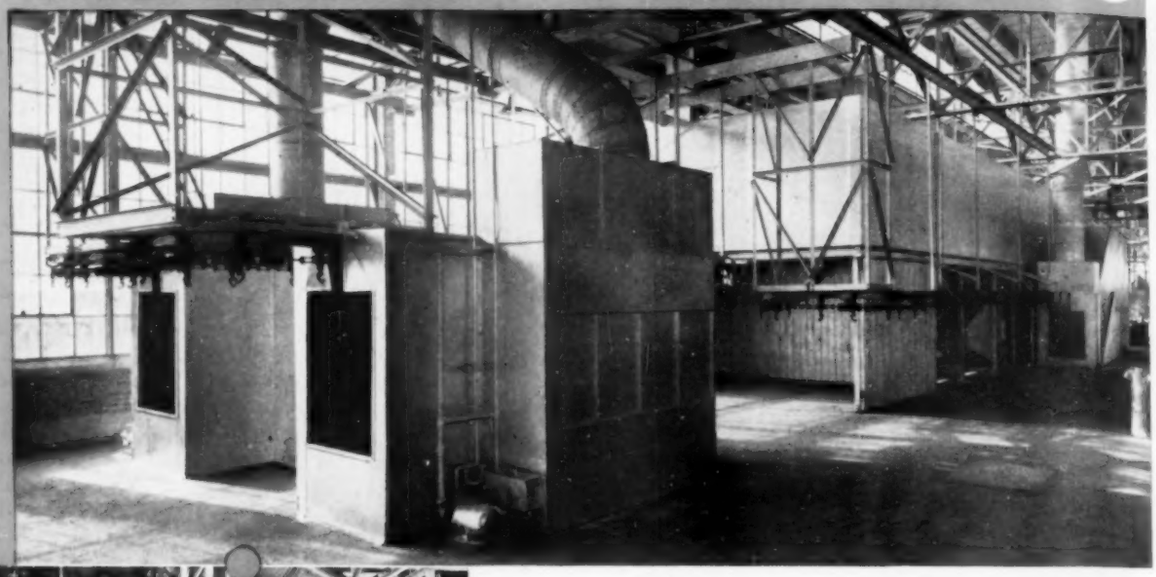
* * *

If finishing materials are stored in cold storage rooms and then taken to the warm room where they are used, considerable time is required for the finishing materials to be warmed up to the temperature of the room in which they are to be used. If cold materials are mixed, proper mixing may be difficult. To insure proper warming of the finishing material, it is suggested that it be removed from the storage room to the finishing room the night before it is to be used, to allow at least twelve hours for the material to arrive at the finishing room temperature.

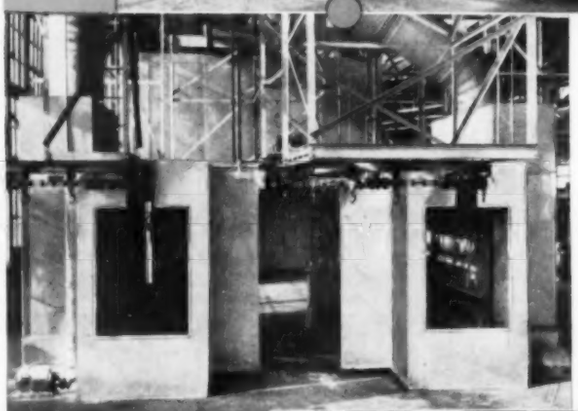
* * *

If you have to mix a small quantity of finishing material and the quantity is too small to strain by the usual methods, just put the material in a low cup or pour it onto a piece of metal then place a piece of straining cloth over the material and it will bleed through, thus obviating any difficulty from grit remaining in the material.

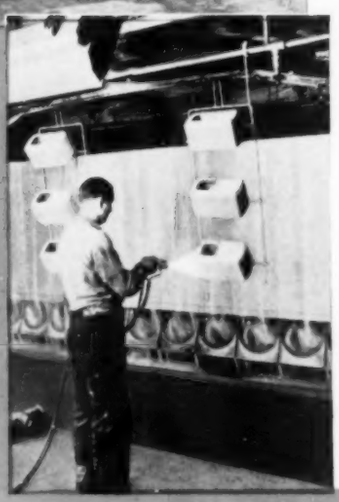
For Peak Efficiency in Modern Industrial FINISHING



At the right is the complete Mahon Finishing System installed at the Allis-Chalmers plant, Pittsburgh, Pa. This is the third Allis-Chalmers plant to be equipped with a complete Mahon Finishing System.



Two Mahon Hydro-filter Spray Booths — part of the complete Mahon Finishing System at Allis-Chalmers, Pittsburgh, Pa.



Interior of a typical Mahon Hydro-filter Spray Booth showing Flood Sheets, Conical Sprays, and Circular Orifice Plates.

. . . a Thoroughly Engineered Mahon System is the Answer

The best proof of the above statement lies in the fact that Allis-Chalmers has purchased three complete Mahon Finishing Systems over a period of three years . . . three complete systems for three separate plants each manufacturing widely different products. This indicates not only complete satisfaction, on the part of the purchaser, but complete confidence in Mahon's engineering staff as well. Like Allis-Chalmers, many manufacturers in every industry where finishing is a major production operation are turning their entire finishing problem over to Mahon . . . they know that the Mahon organization, backed by seventeen years of research and practical experience in this highly specialized field, is equipped to do a better engineering job on equipment of this type . . . they know also, that a Mahon installation will be perfectly coordinated to produce the desired results in continuous operation. A complete, properly engineered Mahon System will improve the finish on your product, and reduce your finishing costs too. Call in a Mahon engineer now—consultation will not place you under any obligation.

THE R. C. MAHON COMPANY

Detroit — — Chicago

Designers and Manufacturers of Complete Finishing Systems, Metal Cleaning Machines, Rust Proofing Machines, Drying Ovens, Hydro-filter Spray Booths, Baking Ovens, Hydro-foam Dust Collectors, and Many Other Units of Special Production Equipment.

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